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CONTENTS.

	PAGE
Editorial	429
The Telephone War in England	432
Independent Long Distance Telephony in Ohio	432
The Question of Bell Telephone Sub-Company Royalties	432
The Ganz Three-Phase Railway System	433
Telephone Submarine Cable Work on the Milwaukee River	436
The District Telegraph, by Edward A. Calahan	438
The Glasgow Exhibition	439
The Institute Conversazione	439
The Long-Distance Telegraph and Telephone Systems of Pupin, Thompson and Reed—I, by E. F. Roeber, Ph. D.	440
A National Electrical Contractors' Association	441
The Osmium Lamp	442
National Standardization Bureau	442
Taxation of Telephone Companies	443
Electric Automobiles for Hire a Failure in Chicago	444
A State Electrical Laboratory for New York	444
President Glidden on the Erie Telephone	444
More Views of the Berliner Microphone Decision	445
The Drawbacks of "Party" Telephone Lines	446
Seeing by Electricity	446
Current News and Notes	446
LETTERS TO THE EDITORS:	
Automobile Construction, by Philip K. Stern	448
The Electric Sign for Summoning Vehicles, by Max Loewenthal	448
Digest of Current Electrical Literature	449
Gas Engine Igniter	453
Pressure Oil Cup	453
Direct Current Power Motors	453
DEPARTMENTS:	
Financial Intelligence	454
Commercial Intelligence	454
General News	456
Trade Notes	460
Illustrated Record of Electrical Patents	461

AUTOMOBILES IN CHICAGO.

The news that the company running ply-for-hire electric automobiles in Chicago has decided to suspend operations comes as a discouragement rather than a surprise to those who have been watching the situation. Threatened with a serious strike, but unable to increase wages above what was regarded as a fair figure, owing to the heavy cost of operation, the company has decided to abandon its work. This does not mean that electric automobiles will not flourish in Chicago, for aside from a re-organization of the old company, there appear to be others willing to occupy the field, which sooner or later should be one of the best and most profitable in the country.

We had rather hoped that Chicago might show good results, but at the same time had entertained doubts as to the possibility of doing a profitable business at the schedule of prices. So far as we can learn, the cost of maintenance has been extremely high in Chicago, the rubber tires suffering severely from the condition of the streets. The only way to offset heavy operation expenses is to get a large income, but this was denied both by the low tariff and by the lack of liberal patronage. It appears that the use in New York and Boston is proportionately much greater than in the Western center, where the population is overwhelmingly industrial, and where the street car and elevated system is most comprehensive.

We certainly expect to see another attempt made under more encouraging circumstances. Like those of New York, the streets of Chicago are bound to improve, and unlike those of New York, they are already normally level, presenting in that respect ideal conditions for storage battery work. It will be remembered that the question of the battery versus the horse has been most thoroughly thrashed out in these pages by Mr. Fliess and others, with the demonstration on a downright, conservative basis that the battery can compete on more than equal terms. This we still believe to be the truth, and even if it were not, we should still be firm in our conviction that the horse has to go. It has no proper place in city life, and the electric automobile remains one of the best means of replacing it.

THE BERLINER DECISION.

As might be expected, the Berliner microphone decision continues to be a theme of lively discussion in electrical circles. The opinions we quoted last week from a number of well-known concerns and individuals are supplemented by an equally interesting batch this week. It will be noted that in general the independents take hopeful and roseate views, and expect greater activity than ever. As pointed out in an article on another page, from Ohio, it is believed that one immediate effect will be the improvement of apparatus, many old and cheap independent equipments being swept aside and replaced in the march of progress.

One of the elements in the situation is the effect on the telegraph. It is evident that among telephonists at least further encroachments on the earlier art are proposed. But, on the other hand, the Berliner decision may prove to be the salvation of the telegraph service by compelling attention to the desirability of adopting improved "machine," rapid systems. We note elsewhere what is already promised in this direction, and can see no adequate reason why machine teleg-

raphy in the near future may not vastly enlarge the domain now occupied by the sounder and the key. There are various ways in which this result may be effected, and if the telegraph companies should not take up machine work, it seems by no means impossible that the telephone companies may do so, with the object of utilizing their copper circuits after those hours of the day when they are needed wholly for telephone work. The old central station wanted a day load. The modern telephone exchange needs a night load, after the same fashion.

Long Distance Telephony.

In this issue we print the first of three articles on the several methods which have been proposed in order to attain a sufficient practical approach to the distortionless conductor of Heaviside for long-distance telephone and telegraph work. As pointed out by Dr. Roeber, Heaviside—whose shoulders so worthily bear the mantle of Maxwell—laid down the principles upon which a solution of the problem depends, namely, that the remedy lies in an increase of the inductance of the line, whereby both the distortion and attenuation of the currents may be diminished. Dr. Roeber in his articles will consider three methods that have been offered as practical applications of the Heaviside principle. The first taken up is that of Dr. Pupin, which, though the latest proposed, is the first method to enter the commercial stage. In this case the inventor himself thoroughly developed the mathematical theory involved, and the object of the articles is to perform the same office for the systems of Thompson and Reed, the writer following an analytical method analogous to that used by Dr. Pupin.

The National Standardization Bureau.

We print elsewhere the full text of the bill passed in the closing hours of Congress establishing a National Standardization Bureau. The electrical industry is to be particularly congratulated upon the passage of this valuable measure—first, because of its great importance to that industry, and, second, because its success at the present juncture is gladly acknowledged by those in charge of the measure to be due to the influential support it received from the electrical interests. The American Institute of Electrical Engineers was a potent factor in influencing Congressional opinion through the work of its committee appointed to further the measure, and the appearance of Presidents Kennelly and Hering and other members, before the House and Senate committees in the initiatory stages of the bill.

The selection of Prof. S. W. Stratton as director of the Bureau assures that the objects for which it was established will be thoroughly achieved during his incumbency. As the assistant for a number of years of Prof. Michelson, in whose laboratory some of the most refined physical experiments of the age have been carried on, Prof. Stratton is remarkably well qualified to undertake the task of establishing the standards upon which the work of the Bureau will depend for its value. But scientific attainments alone would not be sufficient where success also depends upon the continued support of Congress and the favor of the industrial interests, to whose needs the Bureau is intended largely to cater. When Secretary Gage selected Prof. Stratton to organize the movement in favor of the Bureau, he doubtless had in view the second qualification above implied, and the wisdom of his choice is certified by the result. We feel confident that in his attitude toward the industrial interests concerned in the work of the Bureau, Director Stratton will also be found an administrator fully equal to the demands upon him.

It will, of course, require some months to organize the Bureau, and perhaps a year or more will elapse before it is quartered in the building for which Congress provided in the act. We most sincerely hope, however, that one of the first objects to be provided for will be the testing and supply of secondary incandescent lamp standards, upon application of lamp manufacturers and central stations. This object more, perhaps, than all others combined, rallied the electrical industry in support of the Bureau, and its rapid attainment will serve to keep this interest unflagged—indeed, will still further enhance it. As the appropriation becomes available July 1, we hope it may be possible to inaugurate this branch of the service in the present quarters of the office of Standards, Weights and Measures, which department is now merged into the Standardization Bureau.

The Osmium Incandescent Lamp.

We publish this week some notes on the new incandescent lamp devised by Dr. Auer von Welsbach, possessed of a filament formed of the rare metal osmium. One regards with instinctive respect the work of this distinguished investigator, yet in this instance we are disposed to the opinion that—to drop into the vernacular—he has "barked up the wrong tree." On general principles there is no reason to suppose that the efficiency claimed of 1.5 watts per candle or better for some hundreds of hours is either a misstatement or an exaggeration. On the contrary, aside from the evident mechanical difficulties of producing a filament from a substance of such crystalline tendencies as osmium, inherent probability is in favor of the properties claimed. Osmium is nearly or quite infusible, and at the highest attainable temperatures evaporates somewhat after the manner of arsenic. But it appears to be entirely stable at or about the melting point of platinum and certainly will stand a far higher temperature than carbon filaments at their best. As efficiency in the production of light by incandescence is merely a matter of high temperature, osmium should give, as it apparently does, very remarkable results.

The difficulties to be encountered by the new lamp are of a grimly practical character. Foremost among them is the fact that osmium is too good a conductor, compelling the use of a very long and thin filament to produce a lamp of ordinary voltage and moderate candlepower. As osmium is really on the border line between the metals and the metalloids, it lacks the mechanical properties that permit the construction of a tenacious filament of small diameter, and there would seem to be no reasonable expectation of dodging this difficulty. Twenty-five to fifty volts is stated as the voltage for which osmium lamps can be successfully made. This means a very great limitation of practical usefulness, even supposing there were no other difficulties. The tendency of working voltages is upward, not downward, and limitation to a 50-volt lamp, with the accompanying necessity of burning lamps in series to obtain a reasonable voltage for distribution, is a very serious objection to overcome. For some special purposes such lamps might be usefully employed, but for general or even considerable employment, the low voltage is a handicap not to be overcome by an efficiency of 1.5 watts per candle.

But a far greater and, in our judgment, insuperable difficulty is the rarity and cost of the material. Osmium is found at present only as a trivial component of platinum ore which is itself painfully rare. Crude platinum contains among other rare metals a small amount of osmiridium, which is an alloy of osmium with iridium, containing, say, 25 to 40 per cent of the former metal. Some crude platinum from Australia has shown on analysis as high as 26 per cent of osmiridium or a little over 8 per cent of osmium. But

unhappily the platinum of the Urals which forms the bulk of the commercial metal is very lean in osmiridium, containing usually less than 1 per cent, of which barely a quarter is osmium. It would be well within bounds to say that that osmium is more than a hundred times as scarce as platinum, itself the rarest of the commercial metals. Osmium is at present used in minute quantities as osmiridium and as osmic acid, and is costly in spite of the small demand. If one remembers the tremendous increase in the price of platinum due to its use for the leading-in wires of incandescent lamps, the construction of an osmium filament becomes a commercial absurdity. Unless new sources of supply should render osmium as common as gold at least, it would be hopeless as a material for filaments of incandescent lamps.

There is, moreover, a general objection to continuing the struggle after more and more refractory filaments. And this is the apparent hopelessness of getting any really great increase of efficiency through merely raising the temperature of an incandescent solid. So long as the energy spectrum of the radiant substance is continuous, extending far into the infra-red and the ultra-violet, there will be a considerable amount of radiation which is visually ineffective. Indeal efficiency is to be sought rather in non-production of these ineffective rays than in desperate efforts to intensify the luminous energy in a continuous spectrum. The work of Nernst, Welsbach and others may result in very material improvements but the revolutionary seems to us to lie along another road—a path beset with obstacles, it is true, but worth the following. The glow-worm's secret may never be disclosed to human intelligence, but it is quite certain that it cannot be penetrated by reasearches at transcendental temperatures.

GASOLINE AS A DOMESTIC ILLUMINANT.

We wonder how long before our friends the underwriters, who have displayed such unflagging activity and richness of imagination in dealing with electric lighting as a fire risk, can spare time enough from their investigations to cast an eye on the exploiters of private crematories. We refer to the philanthropic gentlemen who for the past year or two have been engaged in introducing the gasoline torch as a domestic illuminant. Now, the gasoline torch, properly applied, is the valued ally of the electric wireman and the right bower of the lordly plumber, but it is not a proper member of the happy family circle even when crowned with a Welsbach mantle and adorned with a crepe paper shade. For the past two or three years there has been nothing short of a swarming of gasoline Welsbachs under various alluring titles, usually derived from the patronymic of the putative inventor. Like the gold brick and the green goods games, these devices have been most earnestly exploited in the country districts and in the smaller towns, where the underwriters have feeble jurisdiction, and there are only volunteer fire companies in great need of exercise. In such places a mantle burner seems a sun-like marvel of brilliancy, and its fine greenish glare a thing of beauty. More than all, it is cheap, like other green goods, and the prospect of getting something for nothing is just as alluring in the rural districts as in Wall Street.

So the gasoline burner has come with a blare of trumpets at regular advertising rates, and has settled down to steady business in increasing the death and insurance rates. The gasoline gas machine has been known for many years and has taken its place as a useful means of lighting on a small scale where other and better illuminants are not available. It has been worked out in a careful and scientific manner, and when carefully installed has proved to be most excellent and convenient for the lighting of country residences and similar work. And if any one wants to work that system with mantle burners, there is no reason why he should not, if he can stand the color of the light. As the historic book review has it: "This is a very good kind of book for them as likes this kind of a book." But setting up a gasoline tank on your parlor table or in the attic of your store is not a commendably prudent proceeding. The solemn fact is that gasoline is a highly dangerous explosive, far more dangerous to have around the house than dynamite, even supposing the character of both to be known. For if accidentally ignited, a dynamite cartridge will usually burn up without detonation, while the gasoline is sure fire every time and scarcely less destructive. Gasoline, to speak accurately, is a volatile mixture of hydrocarbons of the paraffin series, of density about 0.65, which gives off explosive vapor at all ordinary temperatures and ignites on the slightest provocation. It is by far the most dangerous of the ordinary petroleum products, those more volatile and inflammable being produced in small quantities and not widely used. As a well-known expert recently put it: "The smell of gasoline is explosive." While the substance can be safely used with proper care it is about the last thing which should be turned loose without elaborate warnings as to its nature. And let it not be supposed for a moment that the exploiters of the Jabez Houlihan Light, Limited, explain to their customers that they are dealing with a dangerous substance only to be used with extreme caution. Far from it, for every system of this sort is loudly heralded as entirely safe and so simple that a child can manage it. The most innocent of these "systems" are those devoted to the sale of stock only, paying fictitious dividends from the sale of State rights, for these take only the money of the gullible, without imperilling their personal safety.

But others, less considerate, have sold their infernal machines in large numbers, and the hapless user has done the rest. Already in at least one State the results have been so disastrous in loss of life and property that legal steps have been taken to check the sale of such appliances or to prohibit it altogether. If unchecked, the underwriters will soon find themselves face to face with destruction so serious that they will forget even their favorite "deadly wires" in the presence of the new peril. They have been active enough in harrying the users of acetylene, which is a far safer illuminant, and one which must be seriously reckoned with ere long in spite of their protests; but the self-contained gasoline lamp and all its kind has not yet received from them the attention it merits. Its danger is none the less by reason of the fact that there is good reason to believe that gasoline as sold to-day may mean almost anything. The gasoline as customarily defined in the past, has only been about 3 per cent of the entire petroleum product, but its use has greatly increased under the stimulus of the growing use of explosion engines for launches and automobiles, and one of two things must inevitably happen. Either the gasoline will become so expensive that inventors will be compelled to devise suitable means for utilizing the less volatile and safer petroleum products, or to meet the growing demand the obliging purveyors will class as gasoline such mixtures of the more volatile products as they see fit. In such case look out for components even more inflammable, admirably suited to serve as a priming to explode the rest. In all seriousness, the rapidly extending use of the gasoline torch or its equivalent for illumination is a menace to the safety of country communities that cannot be overlooked. We are not discussing the question in view of possible competition with electric lights, for the gasoline lamps will work their own destruction if left to themselves; but it is a duty that we owe to the community to sound a note of warning in face of an imminent danger.

The Telephone War in England.

At the twenty-seventh annual meeting of the National Telephone Company, of England, the chairman, Mr. J. Staats Forbes, made the announcement that the company intends to fight on in face of the post office competition. Having stated that the profit for the half-year amounted to $1,275,000, he declared that they had come to the parting of the ways, and the great question to be determined was whether they should go on. It seemed to him that they would have to fight for their own hand, and so they would go on using every effort to increase their subscribers and make the very best of their property. As to Government opposition, he could only say, with the greatest respect, that the Government had a great deal to learn, and if it persisted in its object and competed with the company at very low rates it would have a mournful story to tell the House of Commons in 1904.

Mr. Forbes said that the board had exhausted argument, conciliation, offers to deal on the square with the Government, to act with them in friendly competition, and make this company auxiliary to them, so that they might not rush into the folly of spending millions on duplicating the company's expenditure, but without avail. The directors believed that this company would be able to beat the Post Office. They were more adaptable. As a commercial company they were not tied down with restrictions and red tape.

Several shareholders spoke in indignant terms of the Government, and after some further discussion the resolution was carried, as well as one providing for the raising of an extra $5,000,000 by the change of unissued ordinary stock into preferred and deferred

Independent Long Distance Telephony in Ohio.

The growth of the independent long-distance telephone movement in Ohio and surrounding States is effecting a marked improvement in the systems and exchanges of the independent companies through that State and section. According to the statement of a prominent official of the United States Telephone Company, of Cleveland, which is building long-distance toll lines throughout the State, fully three-fourths of the independent home exchanges have rebuilt or are overhauling their equipments in order to secure satisfactory long-distance service through connection with the lines of the United States Company. In a number of cases it has been necessary to do this before any kind of long-distance service could be secured, while in others the managers of the local companies found they must improve their local service or the long-distance service would be of little practical value to their subscribers. In many cases the improvements have amounted to a thorough rebuilding of the exchanges. Unfortunately, many of the exchanges throughout this State as well as in other portions of the country, were built by farmers or small capitalists with whom a saving of expense was the main consideration, and who were satisfied with indifferent service. For local service this was frequently all that was required, but now that long distance service has been introduced, some radical improvements have been necessary, and this high state of efficiency must be maintained if the long-distance service is to give satisfactory results. The vast majority of the small home exchanges have never been in the hands of competent electricians. In too many cases the manager or superintendent has been a young fellow possessed of enough experience to connect up a telephone satisfactorily, but with whom switchboard troubles were intricacies too deep for experiment; and were allowed to remain until skilled attention was imperative.

The United States Company official referred to a case of a large country exchange which had just been connected with the long-distance lines, and which failed to give satisfactory service. The local expert thought the trouble was in the local switchboard, but said he had never been able to find it. Rather than have the service a failure the United States Company sent an expert who located the trouble and made the repair with a few hours' work. For more than a year the local service had been of an inferior quality for want of this day's work by an expert.

It is stated that a member of the local companies in various portions of this State have now become convinced as to the necessity and economy of first-class service, and have made arrangements with practical electricians to overhaul their exchanges at certain periods. The expense of maintaining a first-class expert at all times is too great for many of the small exchanges, and some of them have formed alliances with other exchanges in their district, each company paying a portion of the salary of a skilled man to act as consulting expert. In this direction it might be added this plan forms an excellent opening for young telephone experts to form a clientage among small exchanges, agreeing for a specified sum to inspect their systems at certain periods.

It is stated also that there is a growing tendency towards a standard equipment, and this more than anything else will improve the long-distance service. The official referred to suggested that manufacturers are able and willing to furnish equipments which would give uniform results, but in many cases they are backward about venturing suggestions and furnish the buyer what he asks for regardless of the requirements of the situation.

Improvements in Machine Telegraphy.

Anent the subject of impending changes inevitable in the telegraph and telephone situation, we are able to announce that very recent improvements in machine telegraphy by a well-known inventor who has given this branch of electrics close study for several years greatly advances the probability of cheap and voluminous telegraphy in the near future. The chief objection raised by telegraph managers against automatic working has been the special training required for operating the machines used for perforating messages on tapes. This difficulty has been entirely overcome, it is said, and messages may now be perforated by simple mechanism controlled entirely by the ordinary Morse key, so that every Morse operator in the country is at once available as a machine operator, his work being exactly as in operating a circuit in the ordinary way. Moreover, the perforating machine can be worked hundreds of miles away from the sending key, so that branch or outlying offices can perforate their messages at the distant central or relaying station with the same facility as though the key and punching machine were side by side. This will enable the accumulation by ordinary Morse transmission, of business from all branch lines at central points of distribution ready for forwarding over trunk lines by the rapid-machine system.

Another important improvement comprised in this new development consists in recording the messages in regular Morse dots and dashes without the slightest "tailing" or running together of the signals, owing to static capacity of the line.

The Question of Bell Telephone Sub-company Royalties.

The recent upsetting of the Berliner patent raises the question of whether this may not be to the advantage of Bell sub-companies. The policy of the Bell Company has been for several years past that of a steady reduction in telephone royalties and a steady increase in sub-company dividends. It is estimated that at present the American Telephone & Telegraph Company collects royalties of about $2,000,000 per annum. A large stockholder in one of the American Telephone & Telegraph Company's Western subsidiary companies and a resident of Illinois states, according to the Boston News Bureau, that at the time his company arranged for a perpetual contract with the American Bell Telephone Company, it was understood that when the patent on the Bell receiver expired the royalties on telephones would be discontinued.

"The Bell has met this question only in a partial way; that is, the royalties have been reduced, but we are still paying a royalty equal to 2½ per cent upon our capital stock, and this, taken with the portion the American Bell receives from its holding of so-called franchise stock, brings the total equal to about 4 per cent on all our issued capital. I believe our courts would grant a permanent injunction to prevent our company paying this royalty and that we have a good basis for a suit in equity to recover past royalties paid since the patent expired. If all the minority interests of the Bell subsidiary companies would join together this royalty could be terminated. It is quite an item to pay perpetually on articles that can be bought outright for a small sum, while to the Bell Company the dividends on free stock they have would make up loss of royalties. It is difficult for our company to meet competition for three reasons: First, we pay this large royalty on telephones; second, we are obliged to pay dividends on free stock issued to the Bell; third, we pay 50 per cent to 100 per cent more for manufactured articles than we would have to pay if bought in the open market."

The Ganz Three-Phase Railway System.

ONE of the sections of the paper read by Mr. W. J. Hammer before the February meeting of the American Institute of Electrical Engineers on "Important European Electrical and Engineering Developments at the Close of the Nineteenth Centur," was devoted to the three-phase railway system of Ganz & Co., of Buda Pest.

Through the courtesy of Director Otto F. Bathy, of the Ganz Company, Mr. Hammer was enabled to examine into this system, which is now being installed upon the Lecco, Colico, Sondrio & Chiavenna line in Northern Italy, and which was at the time of his visit installed experimentally upon a circular track a mile in length at Alte-Ofen Island, near Buda Pest, Hungary. The length of the Italian electric road, which up to the present has been operated by steam, is 66 miles, and the maximum grade 22 per cent. The motive power now being arranged for respresents about 7400 hp, with facilities for increasing when necessary. The power will be derived from a waterfall near Morbegno, 9½ miles from Colico and 15½ miles from Sondrio. Four 2000-hp Shuckert three-phase dynamos, generating 20,000 volts at 15 cycles, are direct-connected to four turbines, which are supplied from a raceway between two and three miles long, delivering 35 cubic meters of water per second, and having a fall of 97 ft. The three-phase currents of 20,000 volts will be supplied direct to the line, and 12 sub-stations will transform to 3000 volts and supply 12 independent sections of the railway line. Two overhead trolley wires 3-16 inch in diameter represent two of the phases and the track the third. The line insulators are of porcelain, having five petticoats decreasing in size from top to bottom. The line wire, which is of copper, is ¼ inch in diameter.

The sections of road are operated upon an ingenious block system; when the stop signal is set the line circuit is opened and simultaneously the powerful brakes on the train are set. Passenger and freight traffic are operated independently. The freight locomotives will be of 700 hp, employing four motors, and capable of hauling 250 tons at a speed of 19 miles an hour up a 10 per cent grade. The passenger locomotives are also equipped with four motors, representing 300 hp. The schedule speed is about 37½ miles an hour on the

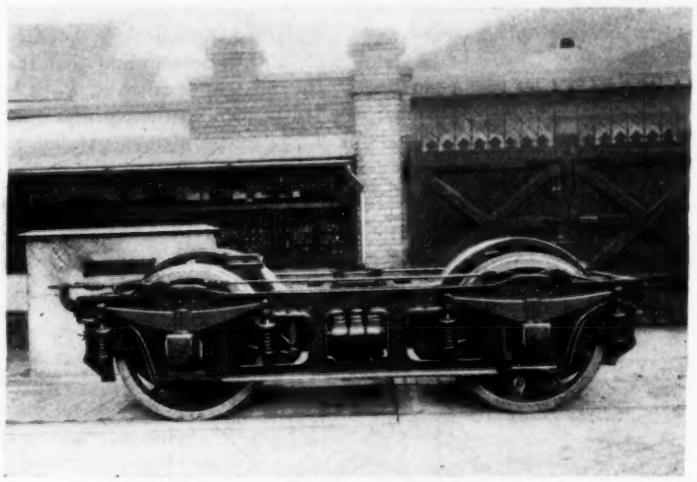


FIG. I.—SIDE VIEW OF TRUCK.

level, and about half that on grades. The 3000-volt current is taken from the trolley lines by two aluminum rollers having a diameter of 3 inches; a collecting-brush running on a graphite collar takes the current from the two rollers and is then led by highly-insulated wires, protected by "grounded" metallic tubing, to the motors. Each car is mounted on two four-wheel trucks, and is equipped with two "primary" and two "secondary" induction motors, or four in all, each of 150 hp.

The 3000-volt currents pass directly to the stationary windings of the "primary" motors. In starting up the train or in climbing a grade the motors are connected in "cascade"—that is the windings of the "primary" rotors, which are designed for 300 volts, are connected to the stationary windings of the "secondary" motors, while their rotors are connected to the fluid resistances; this gives a speed of about 18½ miles per hour. When speed is attained the controller is thrown to its second point, which throws the stationary fields of the "primary" motors on the line and their rotors on the fluid resistances which are slowly cut out of circuit, the secondary motors meantime being thrown out of circuit. This arrangement gives a speed of 37½ miles per hour.

The wires in both field and rotor windings pass longitudinally through insulated tubes in the iron, and at the ends of the windings are insulated by mica and protected by plates or caps bolted on. The controllers at each end of the car are connected mechanically and the high-tension switches are connected electrically. A small transformer on the locomotive connected to the line delivers current at 100 volts to a three-phase motor for compressing air for use on the air-brakes operating the high-tension switch, raising and lowering the fluid in the resistance boxes (which is simpler than raising the plates), and for raising and lowering the trolley. The same transformer supplies current for lighting the train. Cruto "three-phase" incandescent lamps are employed; the periodicity being but 15 per second, the fluctuations were too noticeable in the ordinary lamps, so the Cruto three-filament lamp was employed and showed no fluctuation.

The motors are direct-connected to the axle; that is, there is no gearing; the rotor axle is hollow, permitting the car axle to pass

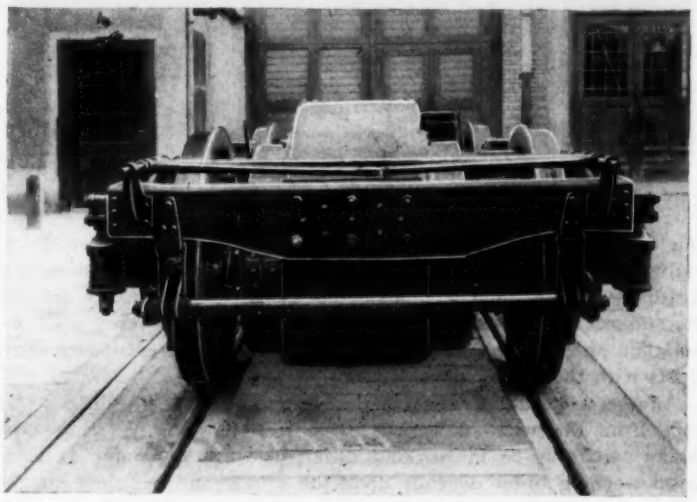


FIG. 2.—END VIEW OF TRUCK.

through it. The rotor shaft and the car wheels are flexibly connected, and thus jarring and vibration are prevented.

Our correspondent in Buda Pest enables us to add the following information concerning the Ganz system as applied in Northern Italy. At present 10 cars are under construction, of which five will carry passengers. Two electrical freight locomotives are under construction, each of which will weigh 40 tons. On down grades the motors will deliver energy to the line. The line will be divided into blocks and a train will cut off the current of the section which it has left and turn the current on again when it has passed over the following section. The next train, therefore, cannot overtake the first one, since the latter has always behind a section which is without current. The accompanying illustrations give two views of a truck, each equipped with two 150-hp two-phase motors. Fig. 3 shows a section of the experimental road at Alte-Ofen, Buda Pest.

In the London *Engineer*, of Feb. 15, is a lengthy article on the North Italy road, a considerable portion of which, however, is devoted to a comparison between the commercial advantages of the Ganz three-phase and the ordinary direct-current system of traction, which merely presents ordinary considerations. As to other points covered in the article, we abstract the following:

Accidents from breakdown of the trolley wires, or their cross suspenders, are provided against in the following way when the line passes through tunnels: Each cross suspender carrying a feeding conductor is passed through a copper ring of, say, 3-inch diameter, supported upon a light insulating bracket, at about 8 inches or 9 inches from the attachment at the side of the tunnel. This ring is the terminal of a stout short-circuiting copper wire. If a trolley wire, or a cross suspender, breaks from any reason, there is, in the first place, a flash across the broken conductor section; but this takes place at the instant of breaking, when necessarily all the wires are still approximately in their orginal high-level positions. Immediately after breakage the whole suspensory system sags heavily and suddenly throughout a long length of the line, and this almost in-

stantaneously brings the feed conductor of the section into contact with the short-circuiting copper ring. Thus a short circuit through an inaccessible route is established several seconds before any of the wires can have fallen on the rails or other earthed conductors. The short-circuited current melts out safety fuses, which at once cut off the whole section. At the same time the trolley wires behind the accident become incapable of supplying power to any following train, which therefore cannot be driven into the neighborhood of the breakdown. In a tunnel there is no question of other wires break-

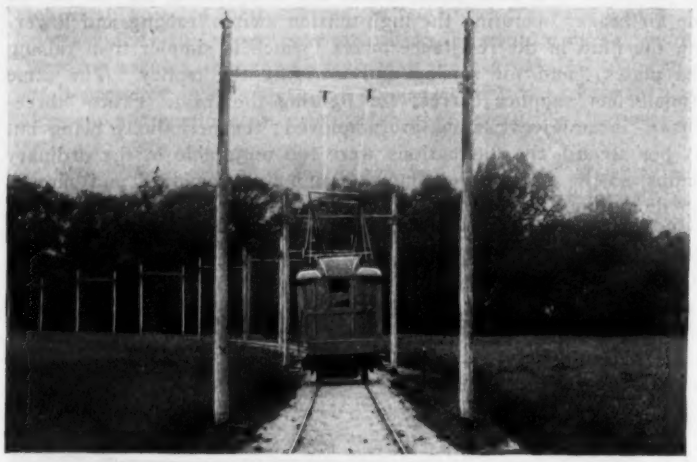


FIG. 3.—VIEW OF EXPERIMENTAL ROAD.

ing and falling on top of the trolley wires. In an open-country railway, all telegraph and telephone wires are crossed, buried underneath the railway and well insulated. In and immediately beyond stations everything except the trolley wires is well covered with insulation, and a complete network of guard wires prevent any accidents with the trolley lines.

Another element of safety in this system is that no train can obtain from the wires power to drive it unless the Westinghouse brake apparatus be in working order, at least, in so far as such good working order depends upon the proper and sufficient supply of air pressure, because, as has been explained, if this pressure fail the trolleys cannot be lifted into contact. The system also lends itself with special ease to the establishment of a complete and particularly efficient block system, the driver of any train being deprived altogether of power to run onto any section which is signaled against him, and of power to leave any section which the signals do not give him permission to leave. The signals switch on the current to the trolley wires of each section only when it is intended that driving power should be taken by a train on this section. Thus also, as regards safety in stations, it is necessary that the trolley wires in the station should be alive only at the time when a train is starting out of the station; they may, after it has cleared out, be left dead until the time for starting the next following train.

For the line in North Italy the motor cars are 18.1 m. long in the carriage body, and 19 m. equals 62¼ ft. over the buffers. The car rests on two bogie trucks placed 11½ m. between bogie pins, each truck having a wheel base of 2½ m. Without passengers they weigh 50 tons, including the motors. The wheels have 1.17 m. diameter, while those of the electric locomotives supplied to the same line have 1.4 m. diameter. The locomotive motor weighs 3.8 tons, its rotor weighing about 1½ tons. The motor car motors, with the smaller size of wheel, weigh 3½ tons approximately. Each cascade pair of these latter develop a full-load horse-power of 150, while the high-tension motor by itself, when running at full speed with the low-tension motor cut out, gives about the same horse-power. Thus, 300 hp are developed in one truck carrying two pairs of motors, or 600 hp equals 450 kw on one train with front and rear driving cars. The momentary overload which these motors are capable of dealing with without damage to themselves is at least four and a half times the normal full load.

The cylindrical face of the rotor is toothed, the core being of stamped mild iron sheet built up and insulated between the sheets in the usual way. The air space is very small, not more than 4 mm or 5 mm. The rotor runs on bearings of ample length and specially large diameter, which are continuously flooded with oil. Large leather ring caps keep the oil from running to waste and from reaching any of the insulation in either rotor or stator. The larger circumferential edge of each leather cap is fixed oil-tight to a flange on the stator frame, while its smaller circumferential edge is cupped inwards and bears upon the running surface of the hollow rotor shaft with a pressure regulated by a light internal steel band tightened up by a small screw union. The internal diameter of the hollow rotor is over 8 inches, and is lined with brass sheet. Outside this sheet the inside of the core is slotted longitudinally to make three recesses, in which lie the cables leading from the windings to the three collector rings. These rings and their carbon-block brushes are entirely encased in a close-fitting cast steel case, on which a small inspection cover is bolted.

The rings are situated at one end of the rotor, while at the other the end plate of the core, which is a flange on the cast steel tubular body, is splayed out on one side so as to give two substantial driving horns, marked R_1 R_2 in Fig. 4. This figure is merely diagrammatic, and is not intended to give the true proportions of the various parts of the mechanism. The weight of this driving extension of the flange on one side is carefully balanced by a counterweight cast on the opposite side, but not shown in the diagram. At R_1 R_2 are pinned to the flange two parallel links of equal lengths stretching to r_1 r_2, where they are pinned to two bell cranks of equal size and form. The centers or fulcra D_1 D_2 of the bell cranks are placed each to the left—as viewed in the diagram—of its link R r, so that the two cranks have dissymmetrical positions relatively to the driving shaft and wheel. Their lower arms are linked together by the coupling rod, L_1 L_2, while the fulcra D_1 D_2 are pins upon bosses in two specially stiff spokes of the wheel. The boss, or nave of the wheel, is keyed in the usual manner to the axle, which passes through the hollow rotor shaft; but the rotor and the wheel are connected only by the linkage just described and through the body frame and the bearing springs. The bore of the rotor shaft is more than 4 inches greater than the diameter of the axle passing through it. The axle runs in axle-boxes sliding vertically between ordinary horn-plates. It carries the weights of the body frame, and of the motor, including the rotor running on bearings fixed in the motor casting and therefore fixed in the body frame, and also of the whole car with its passenger load, through the axle boxes and bow leaf springs and shackles in the ordinary locomotive fashion. This linkage enables the rotor running in such fixed bearings, to drive the wheel while leaving the wheel and and axle free to rise and fall in the horn plates in obedience to the varying bearing spring pressure. Considering the wheel, and therefore the joints D_1 D_2, to be held fixed, and understanding that the link length L_1 L_2 is made equal to D_1 D_2, and also equal to R_1 R_2, it is clear that the bell cranks are constrained to turn on their pivots only through equal angles, that the link L_1 L_2 keeps always parallel to D_1 D_2, that the geometrical line r_1 r_2 also keeps always parallel and of

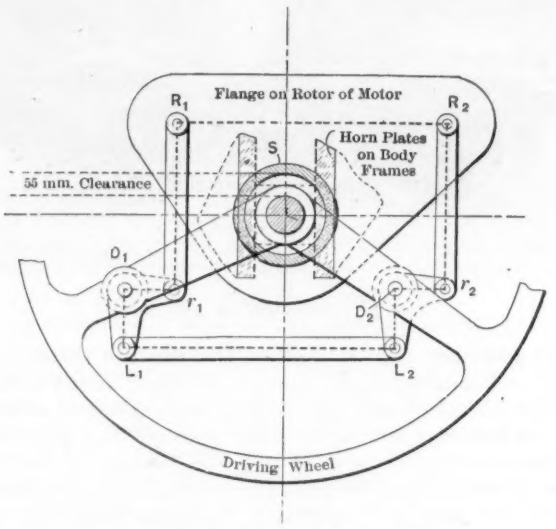


FIG. 4.—DETAILS OF MOTOR ARRANGEMENT.

equal length to D_1 D_2, and therefore also of equal length to R_1 R_2. Thus the geometrical figure R_1 R_2 r_1 r_2 remains always one in which opposite pairs of sides are equal and therefore parallel. In other words, the rotor flange swinging on the base r_1 r_2 by the equal links r_1 R_1 and r_2 R_2 keeps R_1 R_2 parallel, and therefore also parallel to D_1 D_2, the line joining the bosses on the wheel. Two lines, one R_1 R_2 fixed in the rotor flange, the other D_1 D_2 fixed in the driving wheel, are kept continuously parallel. This means that the wheel is rotated

continuously and exactly in correspondence with the rotor. But the swing of $R_1 r_1$ and $R_2 r_2$ permits translatory or non-rotative displacement of the wheel parallel to $R_1 R_2$; while the swing of the equal and always parallel crank arms $D_1 r_1$ and $D_2 r_2$ permits translatory displacement perpendicular to $R_1 R_2$.

The wheel thus driven drives the other wheel keyed on the other end of the axle through the axle. The rotor has a driving flange at one end only. At each instant one of the two links $R_1 r_1$ and $R_2 r_2$ acts by thrust and the other by tension. The two stresses in them are always of equal magnitude, so that the rotor always drives by a pure force couple. The wheel is acted on by a force couple of equal amount, the equal and opposite forces acting through the points $D_1 D_2$. Each of these forces is directed along the line joining D, with the intersection of $R r$ with $L L$. This pair of forces is thus of varying magnitude and varying leverage, but their couple-moment remains always equal to that of the thrust and pull through the links $R_1 r_1$ and $R_2 r_2$.

This linkage illustrates prettily an interesting and important relation connecting the geometrical form and the dynamic action of mechanisms. The geometrical form produces only rotary constraint —it constrains the two parts to rotate together—but leaves them free to suffer translatory displacement. The dynamic result, or necessary concomitant, is that only a force-couple drive between them is possible; the one part cannot produce any resultant bearing pressure upon the other. The actual bearing pressures at the bearings of the rotor are wholly due to the weight of the rotor, and not at all due to the driving forces exerted. The bearings should therefore run very freely and smoothly—although it must be admitted that some variation of direction of bearing pressure is favorable to lubrication.

The induction motors, coupled as described to the driving axle, present decided advantages in respect of mechanical efficiency and minimization of cost of maintenance and repairs. There is no gearing except the simple linkage mentioned; there is no pressure on the bearings except that due to the 1½-ton weight of the rotor; there is no commutator. All high-tension connections are fixed; the connecting rings pass current only during the first half period of acceleration and during the first period of retardation, and during these periods, although the current passed may be considerable, the potential is very low.

The mechanical advantages of having all the bearings of the machine fixed in one rigid body frame will be appreciated by those engineers who have studied the losses of power and the costs of wear in machines in which this desirable fixity of relative positions of all the bearings is not attainable.

The engines used by Ganz & Co. to drive their alternators are made by an English firm, Messrs. Nicholson, in Buda Pest. These engines employ superheated steam, and their most noticeable characteristic is the use of a rolling valve-lever gear, similar in principle, although very different in construction, to that exhibited in Paris on the engines of Stork Brothers, of Hengelo, in Holland. Nicholson was one of the first, if not the very first, engine builder to embody this excellent principle in valve gears.

In continuous-current railway motors the large starting torque required is obtainable only by the passage of a heavy current through the armature, so that the copper section of the armature winding has to be greatly in excess of that needed for the normal working horse-power. Moreover, this large torque is useful only in proportion to the rail adhesion on the one pair of wheels driven by the motor, so that a load has to be heaped onto this one pair of wheels greatly in excess of what can be utilized in developing adhesion after the start. In Messrs. Ganz's cascade system during the start the load-producing rail adhesion is distributed over four wheels instead of two. Moreover, the starting torque is divided between two motors instead of being concentrated in one, whereby the windings are greatly relieved in respect of extra heavy current needed for starting as compared with that needed for normal or average running.

When running synchronously, the motors make 300 r. p. m., the frequency of the current being 15. In the rotor of the same motor the periodicity of the induced currents varies according to the slip. During the start, when the high-tension is switched into "cascade" connection with the low-tension motor, after the speed has risen to "half-speed," or 150 r. p. m.—above which speed this cascade connection ceases—the periodicity of the currents in the rotor or secondary of the high-tension and in the stator or primary of the low-tension, is about 7½ per second. These figures refer to motor cars. The speed of the locomotive motors is 125 r. p. m. The Valtellina locomotive motors are not geared in cascade.

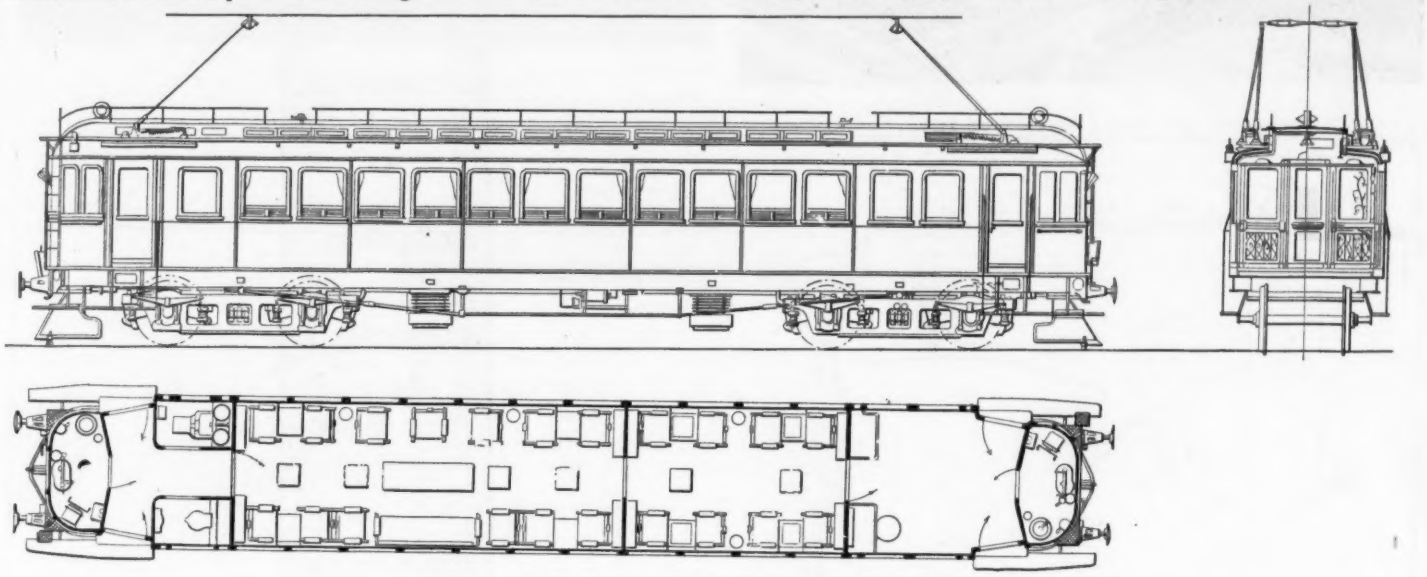


FIG. 5.—ELEVATIONS AND PLAN OF PASSENGER CAR.

Wireless Telegraphy, Past and Future.

The following is from the London *Electrical Review:* Discussing the past history and future development of wireless telegraphy in the ELECTRICAL WORLD AND ENGINEER, Mr. Arthur V. Abbott gives the credit for the initiative to Lord Kelvin's demonstration of the oscillatory nature of the discharge of the Leyden jar. It is rather surprising for an American to overlook the claims of his own countryman, Henry, who, at an earlier date, showed that the Leyden jar discharge was oscillatory, and actually sent wireless signals from the top to the bottom floors of his house. In giving Branly the credit for the invention of the powder coherer, he also overlooks the claims of Varley, who, many years before, had discovered the carbon coherer, and completely explained its action when subjected to electrical impulses. Dr. Chunder Bose's investigations are mentioned by the writer, but what does he mean by his curious deduction "that by a certain mixture of positive and negative substances, any degree of sensitiveness may be arranged"? Surely the aim must be to increase the sensitiveness of coherers, and any mixture of positive and negative substances must reduce it. Mr. Abbott has little faith in the application of syntony in wireless telegraphy, nothwithstanding the successful demonstrations of Marconi in England, and of Prof. Slaby in Berlin. There appears to be no prospect that wireless telegraphy will be used where wire telegraphy is possible, but there are many cases where that is not so. What is wanted is a portable Marconi apparatus that can be carried about the person, by which correspondents that are tuned to one another can talk to each other anywhere within 20 or 30 miles. Such an invention would be invaluable in military operations, but a system of wireless telegraphy which is thoroughly practical over *land* has yet to be devised.

Telephone Submarine Cable Work on the Milwaukee River.

A new departure, so far as telephone submarine work is concerned, has recently been engineered and completed across the Milwaukee River at Milwaukee, Wis. Heretofore the submarine cables for the Wisconsin Telephone Company were laid in the usual manner, viz., after dredging, armored cables were laid across the river. These were frequently interrupted by reason of additional dredging being done by the River & Harbor Improvement Company, and also by ice being jammed in the river.

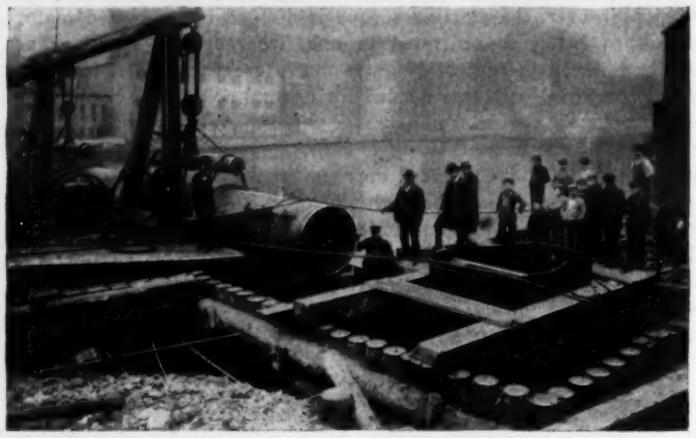
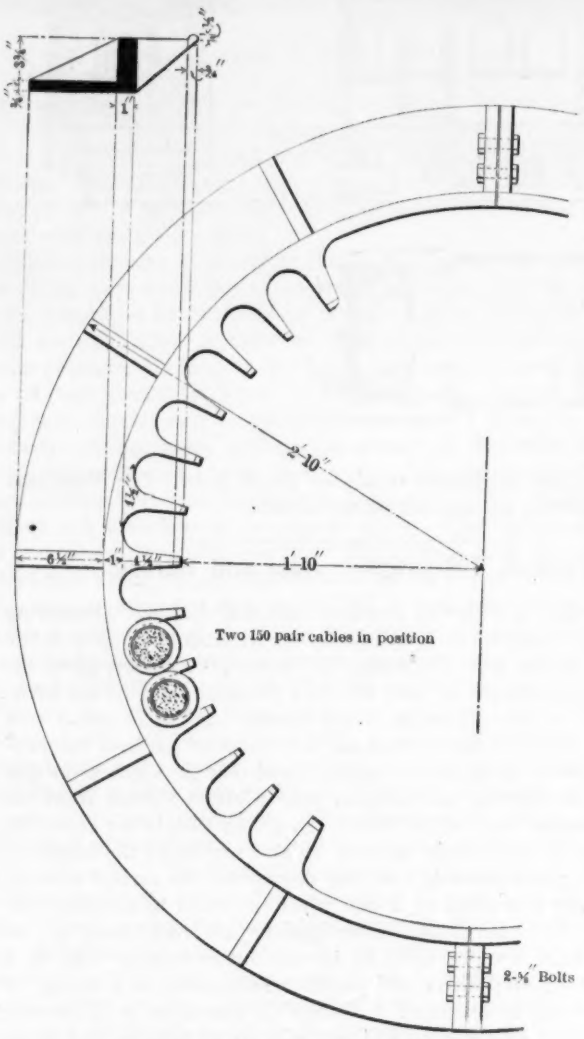


FIG. 1.—LAYING SECTION OF PIPE.



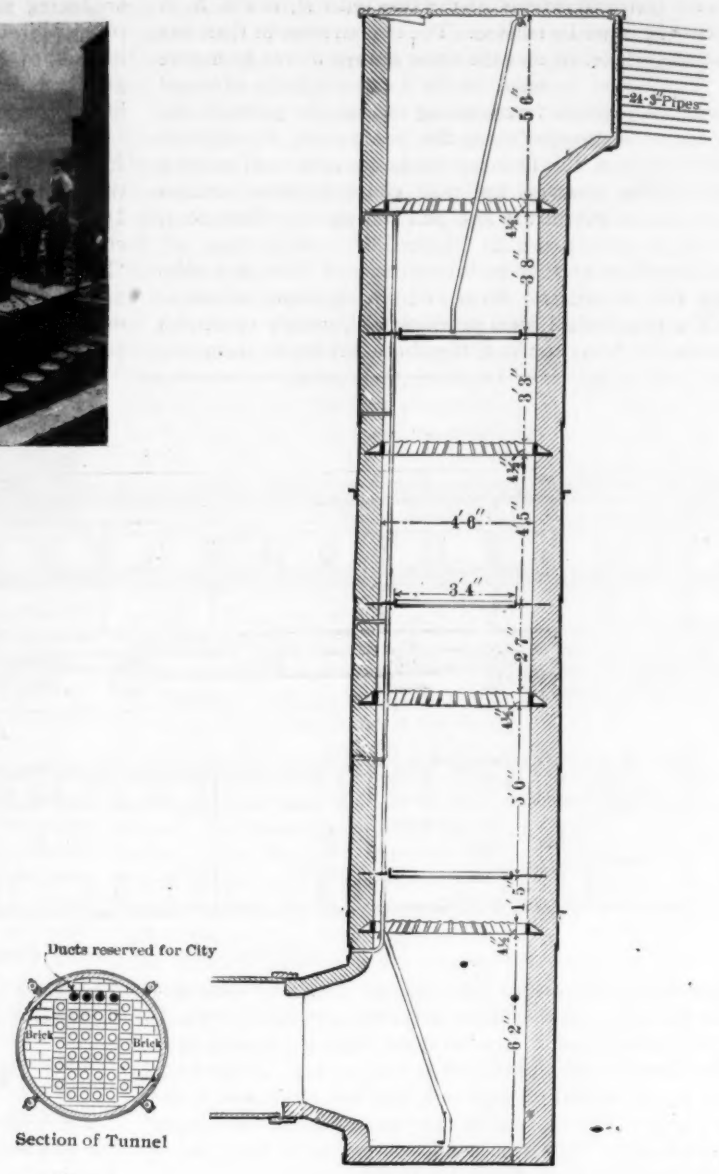
Cast Iron Ring for Support of Cables

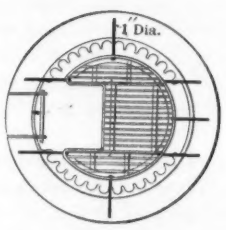
FIG. 2.—DETAILS OF SHAFT AND TUNNEL.

The new work consisted, first, in excavating for a 48-inch iron pipe, to be laid as shown in Fig. 7A and in Fig. 7, whereon, in profile, is shown the original depth of the river and the position of the pipe after being laid, 24 ft. below the Government datum line. The pipe extends entirely across the river, a distance of 256 ft.

On each side of the river a boiler iron shaft 6 ft. in diameter and 28 ft. in length is placed in a vertical position, connecting at its base to a 4-ft. iron pipe. (Figs. 2, 3, 5 and 6.)

After the excavating had been completed, the pipe was laid in sections of 60 ft. each (Figs. 1 and 4), connected to the vertical shafts on either side of the river, weighted down and the water pumped out. The pipe was found to be perfectly dry, after which 34 conduits were laid through the pipe and bricked in solid, and supports for the cable were placed in the brick wall, as shown.





Plan of Shaft

FIG. 3.—DETAILS OF SHAFT AND TUNNEL.

In constructing a subway or tunnel of this character the Telephone Company are insured against any mechanical injury to cables or action of chemicals that may be dumped into the river from time to time. It also gives them a drawing-in system, so that cables may be added as necessity requires. The work of excavating and laying the shafts and pipe was done by the Starkey Dock & Dredge Company, of Milwaukee, Wis. The entire work was done under the

FIG. 4.—LAYING SECTIONS OF PIPE.

FIG. 5.—ONE OF THE VERTICAL SHAFTS.

FIG. 6.—SHAFT IN POSITION.

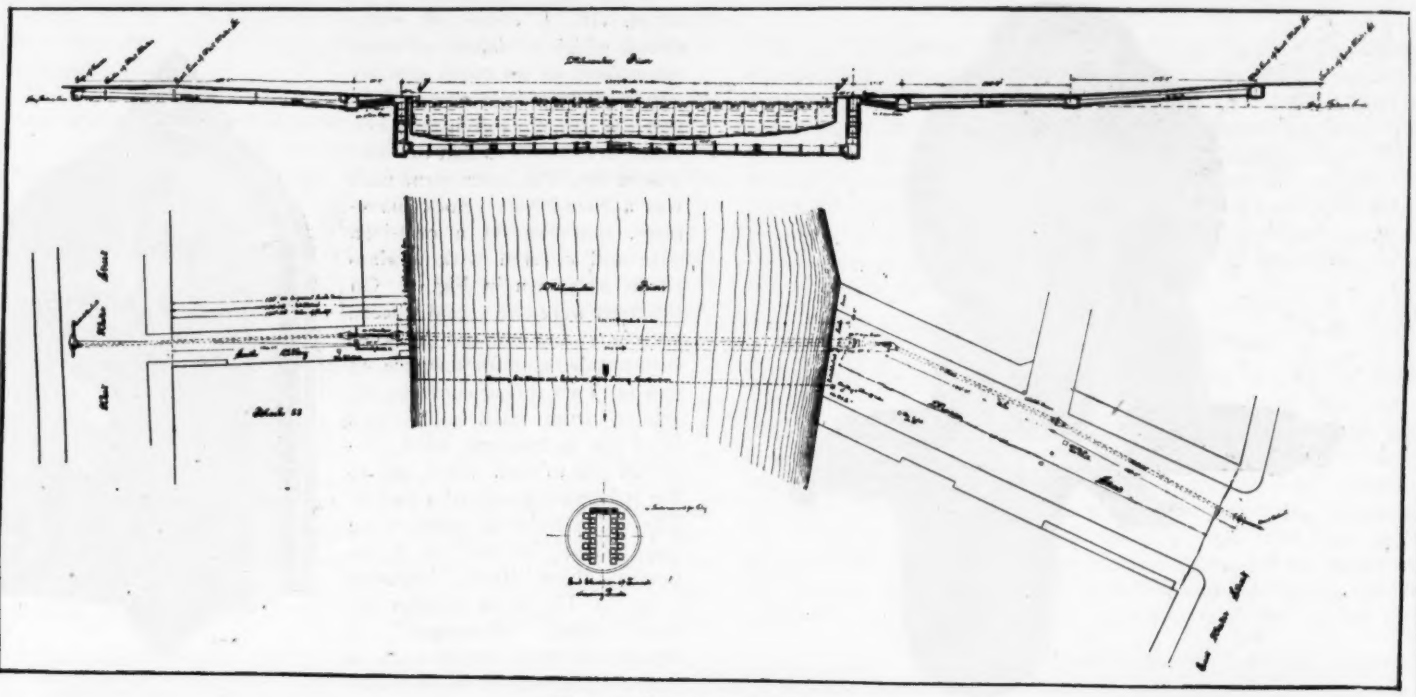


FIG. 7.—MAP AND PROFILE.

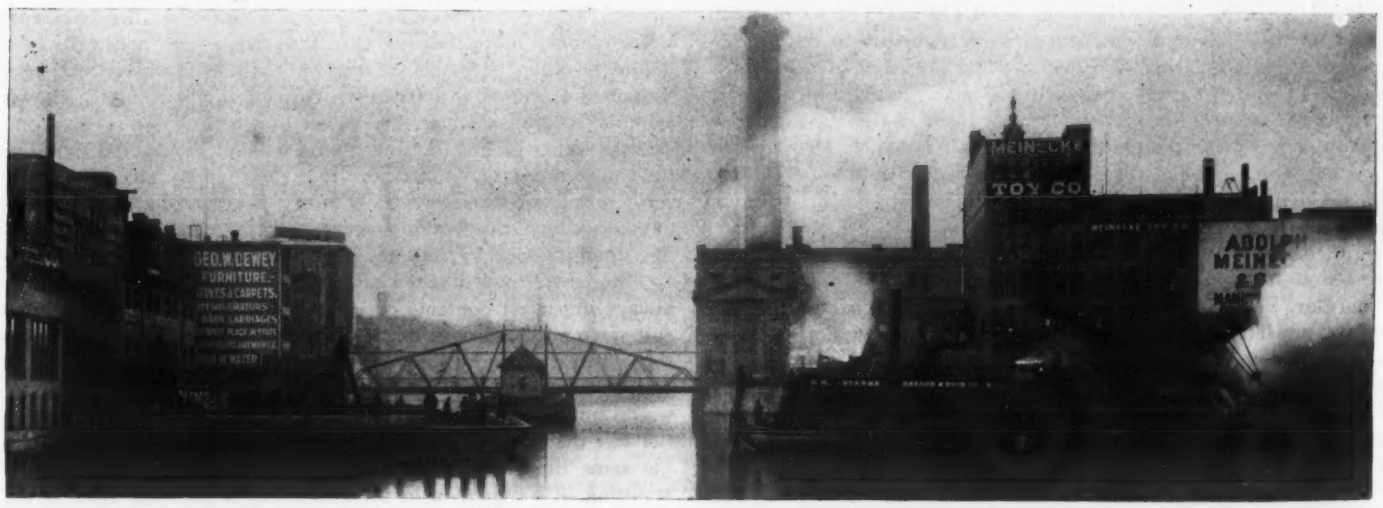


FIG. 7A.—DREDGING AND LAYING PIPE.

TELEPHONE CABLE SUBWAY TUNNEL UNDER THE MILWAUKEE RIVER.

supervision of Engineer John Harper and P. G. Reynolds, general superintendent of construction, the idea originating with the latter.

The Wisconsin Telephone Company have, at the present time, in the neighborhood of 15 cables crossing the river, lying on mud bottom, that will be transferred to the new subway that has been provided for them under and across the river.

The District Telegraph.

BY EDWARD A. CALAHAN.

I NOTE some interesting references and suggestions recently as to the future of the district messenger system, either in conjunction with the telephone or subjected to a keener competition from that quarter. I am loathe to believe, nor do I entertain the conviction, that a service so useful and flexible is likely to be superseded. We shall rather see it developed and its utility even more strikingly brought out than in the past. Meantime, it may be fitting to add to my late articles on the pristine stock ticker and the telephone switch evolution, a few historical and gossipy notes on the early days of the "district telegraph." The call-box, if its vocabulary were not limited to the notches on its wheel, might tell many queer things and ask as many queer questions, among them being when, where and why it was created?

This article is intended to answer these few questions in the interest of somewhat ancient history, by stating causes and events

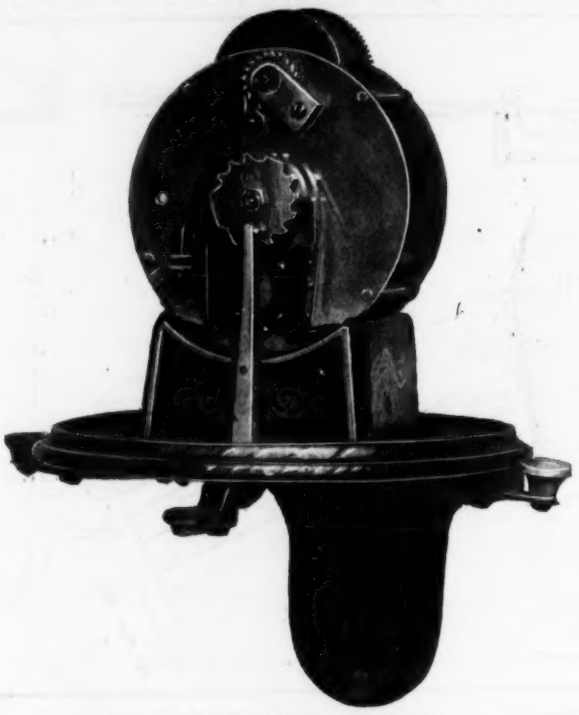


FIG. 1.—EARLY DISTRICT CALL BOX.

which led up to it. The writer was no doubt inspired by personal interest in the gentleman who figured so prominently in the following event: The late Elisha W. Andrews, first president of the Gold & Stock Telegraph Company, resigned his office in 1870, in order to introduce the stock ticker in London. He lived in a fine residence in Englewood, N. J., where there were few other than fine residences. His trunk was packed in readiness for his trip to London. He had bidden his immediate friends good-by, and retired at a late hour. He had scarcely laid his head on the pillow when he saw directed on him the bullseye of the burglar's darklantern. He immediately raised himself in the bed and showed vigorous signs of protest, when the burglar, who had already secured his watch and chain, purse and trousers, and all that was contained therein, threw at him a jimmy, a sharp-pointed and exceedingly dangerous weapon. But for the number and folds of the blankets the jimmy would have fatally injured him. He immediately secured his pistol and fired at the fleeing burglar, but without effect. He next turned his attention toward the barn, where his coachman slept, but the latter did not respond. At daybreak he succeeded in getting some one to go to the residence of a prominent New York banker, who was a near neighbor, to secure a pair of suspenders, stating the reason for the rather strange request. The reply was a "regret" that burglars had entered his house that same night, and had taken nearly all his wardrobe, pocket-book, watch, etc., and that he was about to make a similar request of Mr. Andrews. A third and fourth party were appealed to with almost the same results.

This evidence of over-confidence and want of protection where there were "none of the finest," not even a complacent tenderloin policeman, in a village where only the wealthy could reside, convinced me that a remedy or something approaching one should be applied. Mr. Andrews went to Europe a few days later. During his absence a system for such protection took form. I made personally the first instrument for this purpose. The plan was that each residence (there were at least 50) should be connected in one metallic circuit. A bell in each house, on the fire-alarm order, would wake up the whole village, and the signals would indicate whose house had been entered, or who was in distress. Under such circumstances, neighbors would come personally or send their coachmen or servants, and render whatever assistance might be necessary.

Events frequently change the best laid plans. A servant girl, who had been for many years in the service of a family in one of the best-known residences on Brooklyn Heights, suddenly became insane, and held the family, consisting of an aged lady and her daughter, as prisoners for 24 hours without food or water. That kindred painful incidents were of frequent occurrence, impressed me with the idea that Englewood and such exclusive villages could wait until Brooklyn Heights was protected. I at once devoted my efforts to inaugurate this system in this locality.

In this case I departed very materially from my Englewood proposition, viz., I connected every circuit which contained as many subscribers as we could possibly put in, to the main office, omitting the bell, thus giving no evidence to subscribers that the wire was in use. The instrument used was a round 8-day clock movement, mounted on a cast-iron base and covered with a glass shade, as shown in Fig. 1. On the front were two signal wheels, one containing odd and the other even numbers, as for instance, 13 and 14. Two spring contacts, insulated from each other and from the instrument, were connected one to each wheel, and to the stationary points of a switch. The odd numbered wheel when used called "Police!" or if repeated three times indicated "Fire!" The even number always called "Messenger." If the switch were thrown back or towards the wall it would throw the line on the spring connecting with the odd numbered wheel. This switch was usually kept forward, as the "messenger" call was much more frequent than the "police" or "fire" calls.

FIG. 2.—STANDARD DISTRICT CALL BOX.

The box-like pedestal or support for the clockwork movement contained a magnet and armature, or what might be better known as a miniature box sounder, the object of which was to enable one to know whether or not the line was in use before sending in a signal, thus preventing the mutilation of signals when two or more subscribers signaled at the same time. This was done by depressing the key which threw the magnet into the line circuit by opening the shunt formed by this key when in its normal position. It can now be understood that the call-box offered no resistance, excepting always imperfect contacts or connections. The relays on each circuit were adjusted with a liberal margin allowing for the resistance thrown in the line by some one depressing this shunt key; but when two or more did the same thing and at the same time, the relays would not respond to signals. A mathematical calculation developed the fact that in even 100,000 cases two signals would not come in at the same time. The magnets and shunts were therefore removed, resulting in a reduction in the cost of an instrument from $9 to $6. This instrument required winding about once a year.

The small box now in use and so familiar to the general public, requires no description or explanation beyond the fact that it was wound up by each person while in the act of sending in a signal.

The substitution was justifiable if for no other reason than the difference in cost, viz., from $6 to $1.05.

On Mr. Andrews' return from Europe the American District Telegraph Company was formed, with E. W. Andrews as president, and H. L. Hotchkiss as secretary and treasurer. We began work on Brooklyn Heights, and within a week we secured about 100 subscribers. Having constructed this plant, and demonstrating its practicability, I went to Europe to establish the stock ticker and later the district telegraph system. On my return I found the American District Telegraph in a very active and flourishing condition. At least a dozen branches were established and equipped in New York all of which were well patronized. An applicant for a position as messenger was of necessity well recommended, consequently boys of an unusually high grade were employed.

In many of the branch offices the managers, and in some cases the superintendents have been promoted from the grade of messengers. The stock brokers entrusted these boys with the delivery of stock certificates which were often equal in value to the capital stock of the district company. Every boy was uniformed and numbered, and many of them attracted the attention of prominent brokers and merchants. A record of each and every boy was kept at the main office. It was an almost every-day occurrence for some one desiring to take one of these boys into his service to have his record searched, and if found satisfactory to make application to the company for him. The request was invariably complied with. The result is that today in almost every bank, broker's office, law office and mercantile house, will be found among the best and most trustworthy clerks and employes, one or more who have graduated from a district telegraph office.

The first instrument placed in circuit and the one from which the first signal was received, is preserved in the main office of the American District Telegraph Company, of Brooklyn, and is highly prized by the officers of that company for that reason. That company has paid an annual dividend averaging 5 per cent since 1878, notwithstanding a lively competition in the field, and the naturally expected effect of the telephone which has stunted the growth of all things telegraphic, excepting quotation tickers which must make a record. It also still preserves in police patrol the first object of the invention.

The Glasgow Exhibition.

During the present year the University of Glasgow is to celebrate its 450th anniversary, and at the same time a fine exhibition which will open during the present month will be going on, while a number of engineering meetings and congresses will also be held at Glasgow during the summer months. The various events will be participated in by American electrical engineers, professors, etc, as in various ways electricity will play a conspicuous part. We present herewith a perspective view of the Exposition as now completed, and a map showing the disposition of the buildings and grounds. Those who

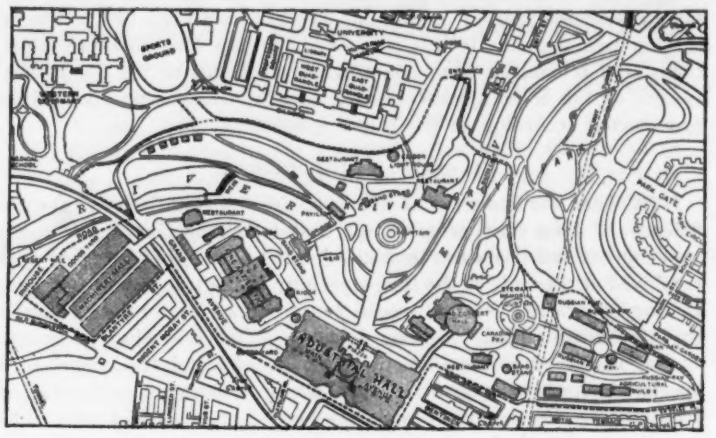


FIG. 2.—PLAN OF EXHIBITION GROUNDS.

70 ft. wide. One of the largest exhibitors will be Russia, which country has spent $150,000 for buildings of striking character. America will have a large representation in various ways.

Altogether, 13 associations have officially intimated to the Corporation their intention of visiting Glasgow and holding their annual meetings there during the Exhibition. They comprise the following: The British Association for the Advancement of Science, Sept. 11; the International Association for the Advance of Science, Arts and Education, from July 15 to Sept. 14; the International Engineering Congress, from Sept. 3 to 5; the Royal Institute of British Architects, Oct. 4; the International Law Association, Aug. 20; Glasgow University Jubilee, June 12; Institution of Naval Architects, June 25; Institution of Chemical Industries, July; British Medical Association, end of August; Loyal Order of Ancient Shepherds (Ashton Unity), July; Institution of Mechanical Engineers, Society of Engineers and Shipbuilders, and the British International Association of Journalists. The exact dates in several cases have not, it will be observed, been definitely fixed.

The Institute Conversazione.

Plans for the conversazione of the American Institute of Electrical Engineers, to be held at Columbia University on April 12, are being developed very vigorously by the committee in charge, and a number of novel and interesting exhibits are promised, as well as some of the first importance. While the affair will be scientific in character, the lighter social side will not be neglected, as provision has already been made for music, collation, etc. The most encouraging feature next to the active interest shown by the members is the desire evinced by prominent inventors and the leading electrical companies to contribute items of intrinsic merit to the list of attractions, and it has been found necessary to impose a limit both as to space and as to time of entry. Lecture rooms, 301 and 302, in the Electrical Engineering Department, will be occupied, as well as 306 and 308 in the Mechanical Engineering Department. The elevators will be in service and cloak and dressing rooms provided on the upper floors. It has been decided by the Council and Committee to issue free to each member a ticket for himself and lady, on application, and a limited number of extra tickets at $1 each. Invitations will be extended to a select list of guests.

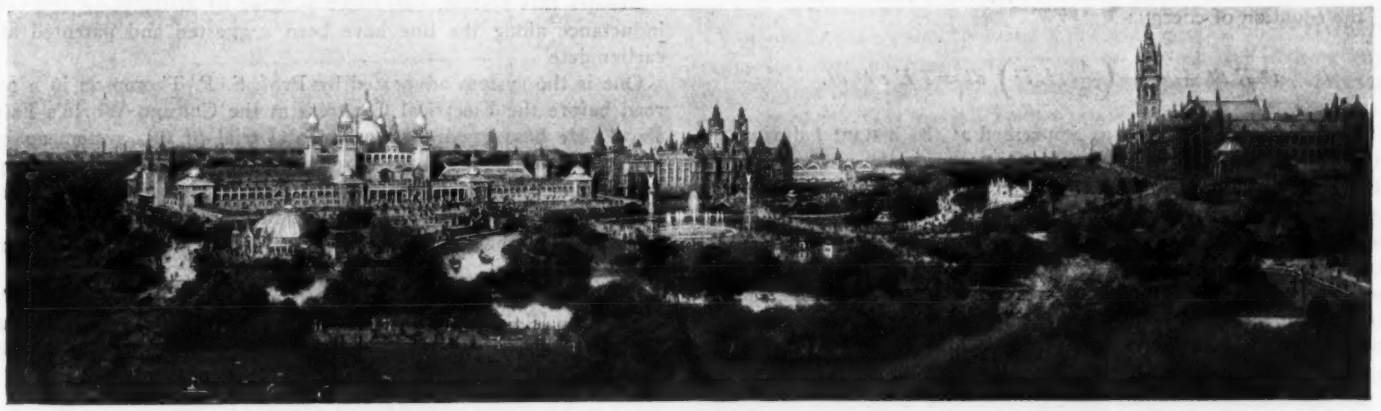


FIG. 1.—GENERAL VIEW OF GLASGOW EXHIBITION GROUNDS.—UNIVERSITY AT THE RIGHT.

are familiar with Glasgow will recognize the University in the fine structure on the hill to the right, while the stream flowing through the valley is that from which Lord Kelvin takes his title. The extent of the grounds is 76 acres, and a stretch of 1500 ft. of river is included for smaller marine exhibits. Some of the buildings will be permanent. The industrial group or section, as noted in the map, is 700 ft. long, 360 ft. wide, and covers some 6 acres. In addition, Machinery Hall is 500 ft. long and 320 ft. wide, with a dynamo room annex about 100 ft. square, and a boiler room 204 ft. long and

The Long Distance Telegraph and Telephone Systems of Pupin, Thompson, and Reed—I.

BY E. F. ROEBER, PH.D.

THE principal purpose of this paper is to develop a mathematical theory of the Thompson system and the Reed system of line construction for long-distance telegraphy and telephony, as described in Section 2, by analogous analytical methods and to the same extent for "forced oscillations," as has been done by Dr. Pupin for his own system. It will be proven that for long distance-telegraphy and telephony, lines constructed according to the Thompson system or the Reed system, behave, to a certain extent, like a line constructed according to the Pupin system.

I. GENERAL INTRODUCTION.

It has been the endeavor of numerous inventors to improve the efficiency of long-distance telegraph and telephone lines. All these experiments and trials can be divided into two classes: First, devices employed at the ends of the line, especially in the transmitting and receiving apparatus; second, special constructions of the line between the transmitting and receiving stations. The following investigation is restricted to the line construction only, and the influence of special devices at the ends of the line or a special construction of transmitting and receiving apparatus will not be considered. The impedance of both these apparatus will be assumed to be zero in our formulas.[1]

Most of our theoretical knowledge of the wave propagation along wires is due to the splendid and persistent work of Mr. Oliver Heaviside. To him is due the general answer to the question how a long-distance telegraph and telephone line should be properly constructed. It was he who pointed out that the dielectric should be the principal object of attention, the wires subsidiary. That the object to be attained in all improvements of line construction is twofold—to diminish "attenuation" and to diminish "distortion"—and that this twofold purpose may be accomplished by an increase of the inductance of the line. As this is of fundamental importance, it may be briefly explained.

How can attenuation and distortion be diminished by an increase of inductance? To diminish *attenuation* means to diminish the loss in the line. Now, which is the part that the inductance of the line plays in the transmission of power?

Let us consider a transmission line having resistance and inductance. We have in each instant, according to Ohm's law,

$$i R = E e^{pt} - L \frac{di}{dt}$$

where $E e^{pt}$ is the e. m. f. impressed at the instant, t, upon the line, i the simultaneous value of the current, and R and L the resistance and self-inductance of the line. Multiply this equation by idt and we get the equation of energy:

$$i^2 R\, dt + \frac{d}{dt}\left(\frac{1}{2} L i^2\right) dt = i E e^{pt} dt.$$

The final term is the energy impressed at the instant t during the time element dt upon the line. The first term is the energy changed into Joulean heat, or the energy lost in the line; the second term is the magnetic energy stored up in the dielectric. To get an efficient transmission of energy, we must make the first term small, the second term large. It is the line itself in which the loss of power occurs, and it is the dielectric in which energy is stored up and propagated along the line. Now we see from the second term of the left side of our equation that for storing up a certain amount of magnetic energy in the dielectric, only one nth of the current is required, if the self-inductance is increased from L to $n^2 L$; in this case, however, we see from the first term of the left side that the loss of energy, due to Joulean heat, is reduced to one n^2th of its value, the resistance remaining unchanged. In other words, the loss in the line —and therefore the "attenuation"—is just as effectively diminished by increasing the inductance as by diminishing the resistance.[2]

The second object to be accomplished is to diminish "distortion." Periodic signals impressed upon the line at the transmitting end can be resolved, according to Fourier's theorem, into a series of sine waves of different frequencies and phases. A distortionless circuit is one that reproduces the currents of all the frequencies at the distant end in proper proportion, attenuated as nearly as may be to the same degree. We know, however, that in general the attenuation increases with the frequency, as will be shown in Section 3. It will also be shown there that this is prevented by making the inductance high. In the extreme case in which the inductance per unit length of line is large in comparison with the resistance per unit length, the velocity of propagation and the attenuation become independent of the frequency. That is, all frequencies are transmitted with the same velocity of propagation and attenuated to the same degree.

The general result is, therefore, that a properly constructed long-distance telegraph or telephone line must have a high inductance.

II. DISTRIBUTION OF SOURCES OF INDUCTANCE ALONG THE LINE.

This general result of Heaviside's theory is, however, not sufficient for practical application. The question arises, how must the sources of inductance be distributed? In any ordinary case of power transmission the capacity of the line can be overcome by the judicious use of reactance coils at the transmitting or the receiving end. But this will obviously not do in the use of wave propagation over long-distance lines. In this case it is evidently necessary to distribute the sources of inductance at equal distances along the line.

Mr. Heaviside's theory did not give any indication about the distances at which the sources of reactance are to be placed. It is this deficiency that has prevented his theory for such a long time from being introduced into practice.

The formation of the mathematical problem corresponding to this question, the development of the analytical methods for solving it, and its solution for the special case of inductance coils distributed

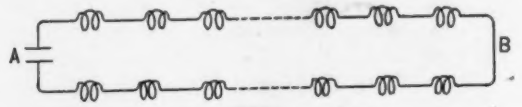


FIG. I.—PUPIN SYSTEM.

at equal distances in series along the transmission line, are to be placed to the credit of Dr. M. I. Pupin.[3]

This special system was first suggested, as far as I know, by Mr Oliver Heaviside in 1893.

The mathematical theory of this system has been given and a rule for the distances at which the coils are to be placed has been developed by Dr. Pupin in his 1900 paper. This system is diagrammatically shown in Fig. 1.

Besides this system, two other systems of distributing sources of inductance along the line have been suggested and patented at an earlier date.

One is the system advocated by Prof. S. P. Thompson in a paper read before the Electrical Congress at the Chicago World's Fair in 1893.[4] He has urged an experimental trial of this system again in his presidential address to the British Institution of Elec. Eng. in 1899.[5] The characteristic feature of the system consists in inserting coils of proper resistance and inductance, shunted at equal distances across the line. This system is diagrammatically shown in Fig. 2.

The other system is that patented by Mr. C. J. Reed in 1893.[6] It consists in dividing the whole circuit into a series of circuits, connected together by transformers in such a way that the secondary of any transformer forms a closed circuit with the primary of the

[1] It would be easy to make our formulas more general by introducing the values of the impedances of the transmitting and receiving apparatus; but I do not see that a clear insight into the influence of the transmitting and receiving apparatus can be obtained in this way. The influence of these apparatus should be considered separately, as it has nothing to do with the main purpose of this paper. In this connection I would like to call attention to an interesting paper by Dr. Breisig on the influence of the transmitting and receiving devices at the ends of a long cable upon the signals (*Elektrotechnische Zeitschrift*, 1900, Dec. 13). The A. I. E. E. paper by Dr. Crehore and Dr. Squier on "A practical transmitter using the sine wave for cable telegraphy; and measurements with alternating currents upon an Atlantic cable," (May, 1900) must also be noticed in this connection.

[2] This explanation is, of course, only intended to show in a special case the part that the induction plays, by storing up energy in the dielectric. The case of wave propagation along a long-distance line is much more general. There is capacity distributed along the line, and we have to consider the storage of both electric and magnetic energy, and the progressive transformation of the magnetic into the electric energy and vice versa. The principal point of the above explanation holds good also in this general case. It is the line in which the loss of energy occurs, and it is the dielectric in which the energy is propagated. And the process is regulated by the inductance.

[3] As his two A. I. E. E. papers on this subject will be repeatedly referred to in the following that on the "Propagation of Long Electrical Waves" (read March, 1899, and that on "Wave Transmission Over Non-Uniform Cables and Long-Distance Air-Lines" (read May, 1900), will be quoted briefly as his 1899 and his 1900 paper respectively.

[4] *Electrical World*, 1893, Sept. 2; *Electrical Engineer*, 1893, Aug. 30.

[5] *Lond. Electrician*, 1899, Nov.

[6] U. S. Patents Nos. 510,612 and 510,613, Dec. 12, 1893.

next transformer. This system is diagrammatically shown in Fig. 3. It will be shown in Section VII. that this system[7] is mathematically equivalent to a combination of the Pupin and Thompson systems.

I am not aware that a theory of wave propagation over lines constructed according to the Thompson and the Reed systems has been

FIG. 2.—THOMPSON SYSTEM.

published. In the conclusion of his 1900 paper, Dr. Pupin remarks briefly that the two cases, illustrated in Figs. 2 and 3, can be worked out by the methods used by him for the analysis of his own arrangement, illustrated in Fig. 1, but he does not give the analysis of those cases.

As I believe that, besides the Pupin system, the Thompson system and the Reed system of line construction may also play an important part in the future development of long-distance telegraphy and telephony, I have worked out the theory of the latter two systems. The analytical methods, used in this investigation, are entirely analogous to those used by Dr. Pupin.

III. WAVE PROPAGATION OVER A UNIFORM LINE.

It will be advantageous to summarize here briefly the theory of wave propagation over a uniform line, as illustrated in Fig. 4. For a complete theory of this case the reader is referred to Dr. Pupin's 1899 paper, Section 1, and to his 1900 paper, Part II., Section 1.

The line is a loop of wire, AB. At A there is the transmitting apparatus which impresses upon the line an e. m. f. of the type $E\,e^{ipt}$. At B there is the receiving apparatus. The impedance of both transmitting and receiving apparatus is assumed to be zero.

FIG. 3.—REED SYSTEM.

Let R, L, C, be the resistance, inductance and capacity, respectively, per unit length of line. R is measured in ohms per mile, L in henrys per mile, C in farads per mile. Let y be the current in amperes at any distance s, — measured from the transmitter A in miles, and let $\xi = l - s$, then the differential equation for y is

$$L\frac{d^2y}{dt^2} + R\frac{dy}{dt} = \frac{1}{C}\frac{\delta^2 y}{\delta s^2} \quad \ldots\ldots\ldots\ldots (1)$$

this equation is satisfied by the integral given by Dr. Pupin

$$y = K_1 \cos M\xi + K_2 \sin M\xi \quad \ldots\ldots\ldots\ldots (2)$$

for all values of K_1 and K_2 proportional to $E\,e^{ipt}$,

$$\text{if } -M^2 = C(-p^2 L + ipR) \quad \ldots\ldots\ldots\ldots (3)$$

If $M = \alpha + i\beta$, we have

$$\alpha = \sqrt{\frac{1}{2}pC\left[\sqrt{p^2L^2 + R^2} + pL\right]}$$

$$\beta = \sqrt{\frac{1}{2}pC\left[\sqrt{p^2L^2 + R^2} - pL\right]} \quad (4)$$

K_1 and K_2 are to be determined from the boundary equations at A and B; this gives

$$y = -\frac{ipCE\,e^{ipt}\cos M\xi}{2M\sin Ml} \quad (5)$$

If the e. m. f. impressed at A upon the line, is the real part of $E\,e^{ipt}$,

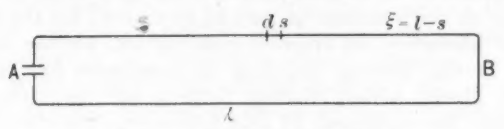


FIG. 4.—UNIFORM SYSTEM.

the current is the real part of y in (5). The wave length λ is $\lambda = \frac{2\pi}{\alpha}$ the attenuation factor is $e^{-\beta\xi}$, where α and β are the values from (4).

It will be seen that, as $p = 2\pi N$ where N is the frequency, the constant β, which determines the attenuation, is the greater, the greater the frequency, i. e., greater frequencies are attenuated more than smaller ones. But it will also be seen that the constant β diminishes as L increases. In the extreme case, in which pL is large in comparison to R, the velocity of propagation becomes

$$v = \frac{p}{\alpha} = \frac{1}{\sqrt{LC}}$$

and the constant β becomes

$$\beta = \frac{R}{2}\sqrt{\frac{C}{L}}$$

i. e., both are independent of p, and all frequencies are transmitted with the same velocity of propagation and attenuated to the same degree, as mentioned in the general discussion of Heaviside's theory in Section 1.

[7] I am aware that this system of transformers distributed along the line has also been suggested by Prof. S. P. Thompson in his 1893 paper in Chicago.

IV. EQUIVALENCE OF NON-UNIFORM CONDUCTORS TO THEIR CORRESPONDING UNIFORM CONDUCTORS.

If the transmission line is not a uniform wire, but contains sources of inductance, uniformly distributed along the line, as in the systems of Pupin, Thompson and Reed, the question arises: How must these sources of inductance be distributed in order to have a beneficial effects? If they are not properly distributed, there will be detrimental effects due to reflections, and the transmission will be worse than on a uniform line.

In his 1900 paper Dr. Pupin has formulated this mathematical problem in the following way: *Under what conditions are non-uniform conductors equivalent to their corresponding uniform conductors?* This question is of great importance and must therefore be clearly understood. "Under what conditions," means: For what distances between the sources of inductance and for what wave lengths (or frequencies)? To be "equivalent" means to have approximately the same wave length and the same constant β, which determines the attenuation. The "corresponding uniform conductor" is a conductor with uniformly distributed resistance, inductance and capacity, the *total* resistance, inductance and capacity being equal to that of the non-uniform conductor which is considered.

For his system of inductance coils in series Dr. Pupin has developed the following very simple rule, which can be best expressed by introducing the term "angular distance" between the inductance coils, defined by the equation

$$\phi = 2\pi\frac{l}{\lambda}$$

where l is the distance (in miles) between two consecutive inductance coils and λ the wave-length (in miles). Then Pupin's rule, proven for his type of non-uniform conductor is: The non-uniform conductor is as nearly equivalent to its corresponding uniform conductor as $\sin\frac{\phi}{2}$ to $\frac{\phi}{2}$.

In the next article I shall develop the mathematical theory of the arrangements of Professor Thompson and Mr. Reed.

A National Electrical Contractors' Association.

A movement is on foot to found a national association of electrical contractors, and an important circular on the subject inviting support has just been issued from Utica, N. Y., by Mr. W. H. Morton, secretary of the New York State body, who will be glad to hear from all interested. In the course of his letter Mr. Morton says:

"In August, 1899, a number of electrical contractors of New York State, held a meeting in Buffalo, and an organization known as the United Electrical Contractors' Association of New York State was formed, the purpose of this organization being for the protection of the mutual interest of the members and promoting a more cordial feeling in the contracting trade. This association takes in the larger contractors in all the cities of the State, and has proved itself a great benefit to all the members.

"In view of the success of this organization it was decided at our annual meeting held in January of this year, to issue a call for a meeting at the Builders' Exchange Building in Buffalo, N. Y., on Wednesday, July 17, 1901, at 10 a. m., for the purpose of forming a National Electrical Contractors' Association. We feel very strongly that such an association will be a great benefit to the electrical contracting trade in many ways, and that the cost to each member for maintaining such an organization would be very small. We have called this meeting in Buffalo, thinking that many of the contractors will arrange to attend the Pan-American Exposition, and consequently will be able to attend this meeting without additional expense."

The Osmium Lamp.

A lecture was delivered Jan. 23 by Engineer Scholz at the annual meeting of the Deutsche Gasgluhlicht Gesellschaft on the new osmium lamp invented by Dr. Auer von Welsbach. The lecturer at the outset emphasized the fact that the efficiency of an artificial source of light is greater the higher the temperature of the light-emitting surfaces. This has led to the substitution of the platinum filament by one of carbon, but even this material disintegrates in time due to the high temperature. Osmium, however, having the highest melting point of all known metals, resists such action for a very long time, but its employment in the form of a filament is of very recent origin. This has been due to the fact that up to the time that Dr. von Welsbach made his experiments, resulting in the manufacture of osmium filaments, the metal could only be procured in the form of a crystalline powder, a spongy mass, or after being molten in the electric furnace, in the form of a brittle, hard metal which could not be mechanically worked.

An osmium filament is a conductor and a lamp containing the same may be placed in an electric circuit like an ordinary incandescent lamp, no preheating devices being required. The advantages of an osmium lamp is its small current consumption for a high-candle power, which in turn means that the carbon filament is worn out long before the osmium filament shows any signs of wear. Lamps requiring 1.5 watts per candle-power possess a very long life, often as high as 700 hours, and frequently as high as 1200 hours and more. A lamp which had been burning 1500 hours was found to be in splendid condition, and had only lost 12 per cent of its original candle-power. The consumption of the lamp at the beginning was 1.45 watts per candle-power, and after 1500 hours it was 1.7 watts.

Should the filament become discolored it can easily be brought back to its original state without renewing it or the bulb. On account of its greater conductivity the osmium filament requires less voltage than the carbon filament, and lamps have been constructed requiring only from 20 to 50 volts.

As most central stations, however, furnish 110 and 220 volts, it would be necessary to burn a number of the lamps in series or to transform the voltage. In the case of alternating and three-phase distribution the problem becomes simpler, as the transformers may be built to reduce the pressure to the amount required by the osmium lamps. They will probably find ample employment on accumulator circuits, as they will reduce the weight of the accumulators on account of their small energy consumption. Among such might be mentioned the lighting of automobiles and railway trains.

During the lecture the speaker connected four 25-volt osmium lamps in series and in parallel therewith four ordinary 110-volt incandescent lamps of the same candle-power. The osmium lamps took .96 ampere, while the others required 2.4 amperes, a saving in favor of the former of 60 per cent. The heat generated is also less in the osmium lamps, and they can be made in candle-powers from 2 to 200.

We are able to supplement the above information abstracted from Engineer Scholz's paper (of which a notice appeared March 2 in the Digest), by the following account of the lamp which formed a part of the recent A. I. E. E. paper by Mr. W. J. Hammer.

During his stay last October in Vienna Mr. Hammer, through the courtesy of Dr. Gallia, of the Auer Company, was permitted to see several of the osmium lamps burning, and while unable to secure full particulars, he learned that the lamps were operated at an e. m. f. of 25 volts, and showed an economy of from .9 to 1 watt per candle. The three lamps which Mr. Hammer saw in use were all connected in parallel and operated with key sockets, and differed but little in general appearance from an ordinary carbon filament lamp. The globe was somewhat longer than an ordinary 16-cp lamp, and the filament, which was of the hairpin shape, was much longer. Mr. Hammer was told that these lamps had shown a life under test of 700 to 800 hours, and he adds that it will be interesting to learn to what extent the low voltage of the lamp and the rarity of the material used in its manufacture will affect its commercial application. It had been intended to show the osmium lamp at Paris before the close of the exhibition, but there was not sufficient time. Osmium, which was discovered by Tennant in 1803, is a blue-white metallic element, and is almost infusible. Mr. Hammer was informed in Paris, where he first heard of this lamp, that the successful method of handling this material, which has always been most difficult to work with, was due to a large extent to Mr. Waldron Shapleigh, of the American Welsbach Company, which concern controls the patent rights for the United States.

National Standardization Bureau.

As stated in our issue of last week, the bill establishing a National Standardization Bureau passed both Houses of Congress in the closing hours of the session. The late introduction of the bill was a serious handicap, and that it secured the preference leading to action is to be ascribed to the great merits of the measure and to the indefatigable manner in which those in charge of its interests labored to impress these merits on the attention of Congressmen. The bill as passed is printed below. The changes introduced in the original bill consisted in lowering the salary of the director from $6,000 to $5,000 per year, reducing the staff slightly and reducing the items for building and equipment. These curtailments will not affect the usefulness of the Bureau at the commencement, and can be made the subject of future legislation.

1. That the office of Standard Weights and Measures shall hereafter be known as the National Standardizing Bureau.

2. That the functions of the bureau shall consist in the custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the Government; the construction, when necessary, of standards, their multiples and sub-divisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

3. That the bureau shall exercise its functions for the Government of the United States; for any State or municipal government within the United States; or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments. All requests for the services of the bureau shall be made in accordance with the rules and regulations herein established.

4. That the officers and employees of the bureau shall consist of a director, at an annual salary of $5,000; one physicist, at an annual salary of $3,500; one chemist, at an annual salary of $3,500; two assistant physicists or chemists, each at an annual salary of $2,200; one laboratory assistant, at an annual salary of $1,400; one laboratory assistant, at an annual salary of $1,200; one secretary, at an annual salary of $2,000; one clerk, at an annual salary of $1,200; one messenger, at an annual salary of $720; one engineer, at an annual salary of $1,500; one mechanician, at an annual salary of $1,400; one watchman, at an annual salary of $720; and one laborer, at an annual salary of $600.

5. That the director shall be appointed by the President, by and with the advice and consent of the Senate. He shall have the general supervision of the bureau, its equipment, and the exercise of its functions. He shall make an annual report to the Secretary of the Treasury, including an abstract of the work done during the year and a financial statement. He may issue, when necessary, bulletins for public distribution, containing such information as may be of value to the public or facilitate the bureau in the exercise of its functions.

6. That the officers and employees provided for by this act, except the director, shall be appointed by the Secretary of the Treasury, at such time as their respective services may become necessary.

7. That the following sums of money are hereby appropriated: For the payment of salaries provided for by this act, the sum of $27,149, or so much thereof as may be necessary; for the erection of a suitable laboratory, of fireproof construction, for the use and occupation of said bureau, including all permanent fixtures, such as plumbing, piping, wiring, heating, lighting and ventilation, the sum of $100,000; for equipment of said laboratory, the sum of $10,000; for a site for said laboratory, to be approved by the visiting committee hereinafter provided for and purchased by the Secretary of the Treasury, the sum of $25,000, or so much thereof as may be necessary; for the payment of the general expenses of said bureau, including books and priodicals, furniture, office expenses, stationery and printing, heating and lighting, expenses of the visiting committee, and contingencies of all kinds, the sum of $5,000, or so much thereof as may be necessary, to be expended under the supervision of the Secretary of the Treasury.

8. That for all comparisons, calibrations, tests or investigations, except those performed for the Government of the United States or State governments within the United States, a reasonable fee shall

be charged, according to a schedule submitted by the director and approved by the Secretary of the Treasury.

9. That the Secretary of the Treasury shall, from time to time, make regulations regarding the payment of fees, the limits of tolerance to be attained in standards submitted for verification, the sealing of standards, the disbursement and receipt of moneys, and such other matters as he may deem necessary for carrying this act into effect.

10. That there shall be a visiting committee of five members, to be appointed by the Secretary of the Treasury, to consist of men prominent in the various interests involved, and not in the employ of the Government. This committee shall visit the bureau at least once a year, and report to the Secretary of the Treasury upon the efficiency of its scientific work and the condition of its equipment. The members of this committee shall serve without compensation, but shall be paid the actual expenses incurred in attending its meetings. The period of service of the members of the original committee shall be so arranged that one member shall retire each year, and the appointments thereafter to be for a period of five years. Appointments made to fill vacancies occurring other than in the regular manner are to be made for the remainder of the period in which the vacancy exists.

Taxation of Telephone Companies.

An article was published in these pages recently as to the basis of telephone taxation in Michigan. The work in other States may be followed with advantage. The report of the Tennessee Railroad Commission, issued in December, 1900, shows that in arriving at the valuation of the property assessed the Commission had in view and looked to the capital stock, corporate property, gross receipts, market value of the shares of stock and bonded debt and the franchises of each company assessed for the years 1899 and 1900. In fixing the value of the telegraph and telephone property they assessed only the lines of wire, poles, instruments, batteries, etc. The real estate and personal property was not assessed.

The total wire mileage of the lines of telephone companies operated in the State is 10,320, which shows an increase since the assessment of 1897 of 3198 miles. A number of local telephone companies chartered and operated in the State were assessed, but after deducting the exemption of $1,000 allowed under the statute, had no value upon which a tax could be levied. They were as follows:

Pittsburg Telephone Company, valued at	$425.00
Selmer & Tennessee River Telephone Company	930.00
Fraley Telephone Company	520.00
Whitleyville Telephone Company	760.00
Gravel Hill Telephone Company	112.50
Meigs County Telephone Company	522.25

The telephone companies assessed after having deducted from their value the sum of $1,000, and the remaining assessed valuation, are:

	Miles.	Per Mile.	Total.
Bristol Telephone Company	41	$48.78	$2,000.00
Carroll County Telephone Company	43	16.74	720.00
Citizens' Telephone Company	420	20.76	8,719.20
Cumberland T. & T. Company	5,208	85.00	442,680.00
Dixie Telephone Company	134	30.00	4,020.00
East Tennessee Telephone Company	3,395	40.00	135,800.00
Gainsboro Telephone Company	194	25.00	4,850.00
Harriman Telephone Company	24	34.00	816.00
McMinnville Telephone Company	50	30.00	1,500.00
Nash. & K. Telephone Company	80	15.00	1,200.00
Newport Telephone Company	49	50.00	2,437.50
Nolachucky Telephone Company	112	30.00	3,360.00
People's T. & T. Company	619	32.50	20,117.50
Totals	10,369		$628,220.20

The Cumberland Telephone & Telegraph Company and the East Tennessee Telephone Company are Bell licensee companies, which probably accounts for the high asssessed valuation per mile, the property of the former being assessed at $85 per mile, or nearly three times the average assessed valuation of the 11 independent companies. And 92 per cent of the total assessed valuation is on Bell lines; that is, the total assessed valuation of the independent lines is $49,740.20, while the Bell lines are assessed at $578,480. Of the 10,369 miles assessed, 8603 miles, or 82 per cent, belong to the Bell companies, and 1766, or 18 per cent, to the independents.

This method of taxing the number of miles of line is followed in other States than Tennessee, though in certain commonwealths the distinction is carefully drawn between the number of miles of pole line and the number of miles of wire. Connecticut, for instance, taxes each mile of wire used by the telegraph companies at 25 cents per mile, the Western Union paying a tax of $3,783 on its 15,132 miles of wire within the borders of that Commonwealth.

This method is also followed in taking the 8552 miles of wire used by the American Telephone & Telegraph Company (the Bell long-distance lines). But Connecticut secures its taxes from the local telephone companies by taxing the transmitters at 70 cents each, which is a more equitable method in many respects. And in the case of long distance companies the transmitters are also taxed.

Thus the annual report of the Treasurer of the State of Connecticut for the year 1900 shows that six telephone companies were taxed on this basis, four of the six being independent companies and two Bell licensees, namely:

	Transmitters.	Value.
Ansonia Telephone Company	223	$156.10
Cornwall Telephone Company	5	3.50
New Britain Telephone Company	119	83.30
Farmington Valley Telephone Company	4	2.80
South New England Telephone Company (Bell)	11,440	8,008.00
American Telephone & Telegraph Company (Bell)	34	23.80
Totals	11,825	$8,277.50

That is, the Bell interests pay $8,031.80 taxes on 11,474 transmitters, or 97 per cent of the total taxes on transmitters, for having 97 per cent of the telephones in the State.

In Maine a direct tax is placed on all telephone companies, and the companies reported for the year 1900, and the amount of tax each is expected to pay, is as follows, the report showing that the Bell licensee pays 89 per cent of the taxes:

Dirigo Telephone Company	$250.00
Eastern Telephone Company	250.00
Nash Telephone Company	65.82
Princeton Telephone & Telegraph Company	12.50
White Mountain Telephone Company	557.02
New England Telephone & Telegraph Company (Bell)	9,885.12
Total	$11,020.46

Alabama does not assess telephone companies doing only a local telephone business. But it does assess long-distance telephone companies, classifying such as telegraph companies. Thus the American Telephone & Telegraph Company (Bell dong distance) is assessed on a valuation of $2 per pole, making an average valuation per mile of pole line of $80, on a basis of 40 poles per mile. This rate is nearly three times higher than the average assessment per mile of telegraph pole line, the railway telegraph lines being assessed at from $10 to $25 per mile, and the Western Union lines at $36. Then the miles of wire on the long-distance poles is assessed at $20 per mile. The assessment report shows that this company has in Alabama 18,598 poles at $2, $37,196; 2,378.52 miles of wire at $20, $47,570.35; instruments, $1,877; total, $86,643.35.

In New Hampshire the telephone tax is paid to the State Treasurer, and is not divided with towns and counties, as is the case with the railroad tax, but is held by the State as part of its revenue. The report of the State Board of Equalization for the year 1900 shows the assessed valuation of the seven telephone companies to be $347,700, on which a State tax of $5,910.90 was levied.

Of this assessed valuation of $347,700, 89 per cent, or $310,000, is on Bell properties, and 11 per cent, or $37,700, is on independent telephone properties, as follows:

Citizens' Telephone Company, Laconia	$20,000
Northern Telephone Company	15,000
Ossipee Valley Telephone Company	1,500
Granite State Telephone Company	600
Colebrook, St. & C. L. Telephone Company	600
Plymouth & Campton Telephone Company (Bell)	10,000
New England Telephone & Telegraph Company (Bell)	300,000
Total	$347,700

In Maryland telephone companies pay a tax on the aggregate value of charges of stock, on the assessed value of real property, and a further tax of 2 per cent is levied on the gross receipts. The amount of the gross receipts reported for the year 1899, the latest printed report issued by the State Taxation Commissioner, is shown below:

The total gross receipts reported were $419,645.12; of this amount $396,691.15, or 94 per cent, was reported by the two Bell licensees, and $22,953.97, or 6 per cent, by the 11 active independent companies. Two of the independent telephone companies named entered a formal appeal from the assessment of the State Tax Commissioner. In one case the Controller and Treasurer reaffirmed the assessment; in the other, the Western Maryland Telephone Company, the "aggregate value of the shares of stock" was reduced from $6,225 to $2,075. Referring to appeals taken by corporations, the State Tax Commissioner suggested a change in the law that would enable the county or the city in which the appellant corporation is operating to appeal from the assessment of the State Tax Commis-

sioner after his valuation is announced, just as a corporation may appeal from the valuation if believed to be excessive.

The county or the city officials may possess information not likely to reach the State Tax Commissioner that would show that

Name—	Gross Receipts.
American Telegraph & Telephone Company (Bell)	$53,343.36
Chesapeake & Potomac Telephone Company (Bell)	343,347.79
Gross receipts of Bell licensees	$396,691.15
Baltimore & Bel Air Telephone Company	478.87
Baltimore, Annapolis & Drum Point Telephone Company	22.55
Boyd Telephone Company	.....
Citizens' Telephone Company	.....
Dorchester Telephone Company, Cambridge	1,958.03
Enterprise Telephone Company	1,424.57
Gordon Telephone Company	796.00
Gapland Telephone Company	.....
Harford County Telephone Company, Bel Air	2,092.23
Interstate Telephone & Telegraph Company, Frederick	6,193.22
Montgomery County Telephone Company	1,138.50
Maryland Telephone Company, Baltimore	.....
Princess Anne Telephone Company	425.00
Salisbury Telephone Company, Salisbury	2,200.00
Standard Telephone Company, Baltimore	.....
Western Maryland Telephone Company	6,225.00
Gross receipts of independent companies	$22,953.97
Total gross receipts of telephone companies	$419,645.12

the assessment placed upon the capital stock of the corporation by the Tax Commissioner is too low, and therefore unjust to city or county.

Electric Automobiles for Hire a Failure in Chicago.

Considerable disappointment has been felt in electrical circles at the announcement that the operation of "ply-for-hire" electric automobiles in Chicago is to be given up by the local company, owing to the small use made of the vehicles by the public and the heavy cost of maintenance due to the bad condition of the streets. As the matter is one of general interest to the electrical community, we give below the full text of the circular issued to the stockholders by President Insull:

The Illinois Electric Vehicle Transportation Company was organized on May 5, 1899, under the laws of New Jersey, with an authorized capital stock of $25,000,000 to be represented by 250,000 shares of $100 each. At a meeting of the stockholders held April 5, 1900, said authorized capital stock of the company was reduced from $25,000,000, divided into 250,000 shares of the par value of $100 each, to $2,500,000, divided into 250,000 shares of the par value of $10 each. Of the capital stock of the company there have been actually issued 158,620 shares of the par value of $10 each. One hundred and twenty of said shares, or a total of $1,200 par value, have been fully paid. Upon the remaining 158,500 shares of the par value of $10 each, this company has received $5 cash on each share. The total money received by this company on stock subscriptions has been $793,700. There has been paid to apply on the purchase price of the real estate, being the leasehold interest at 171-175 Michigan Avenue, Chicago, Ills., $50,000. There has been invested in the improvements of said premises $31,760.35. There is owing as part of the purchase price of said real estate $150,000 secured by mortgage on said property, which bears interest at the rate of 4¼ per cent per annum, and is due on or before Oct. 7, 1904. The interest accrues semi-annually on said mortgage and has been paid as it matured. The company began actual business on or about Sept. 13, 1899. There has been expended up to Feb. 1 for vehicles, machinery, apparatus, materials, supplies, utensils, fixtures, labor, etc., approximately $643,588.42. The gross income of the business to Feb. 1 has been $137,106.90; the total expenses of operating and conducting said business, including all administration costs, has been $265,885.37, thus showing a loss of $128,778.47, with additional loss in depreciation of vehicles and station equipments. There was cash on hand or in bank to the credit of the company on Feb. 1 $205,458.13, and the company now owns 109 vehicles.

Outside of the $150,000 mortgage debt, which is secured by trust deed on the leasehold interest and plant, the company has no debts other than current liabilities, which did not exceed on Feb. 1, $23,000. The company is the lessee of two sub-stations, one lease on Cottage Grove Avenue at an annual rental of $1,167, expiring April 30, 1905, and the other on North State Street, expiring on April 30, 1902, if notice of termination be given to the lessor before Jan. 1, 1902, the rental of which is $1,000 per year.

Your board is of the opinion that owing to the local conditions and the consequent high cost of maintenance, the vehicles now owned by the company cannot be operated in the city of Chicago on a profitable basis. Your board is, therefore, of opinion that it would be advantageous to this company and its stockholders if this company in manner provided by law, be dissolved as soon as possible and its assets converted promptly into cash, the same to be distributed ratably among its stockholders. Your board has procured the consent of the Electric Vehicle Company to a cancelation of the contract between that company and this company, together with the settlement of all existing claims as between the two companies, and an exchange of mutual releases, such cancellation of contract to be subject to approval of the stockholders of this company.

The terms of the agreement with the Electric Vehicle Company were that it should receive 20 per cent of the authorized capital stock issued and 2½ per cent of the gross income from vehicle operation.

A State Electrical Laboratory for New York.

Attention was called recently in these columns to the bill now before the New York Legislature founding a State electrical laboratory. The New York *Sun* has jumped on this bill and stamped it hard with both feet. President A. V. V. Raymond, of Union College, the proposed beneficiary, replies as follows to the attack:

Your clear statement of the provisions of the bill leaves nothing to be desired in that particular. It proposes to build and equip a State electrical laboratory at Union College and to provide for its maintenance and for the work of experimentation and instruction. The college is to deed to the State the land needed for the laboratory and to offer to students resident in the State 100 free scholarships in electrical engineering. The passage of such a bill would be justified by certain considerations which I wish to call to your attention.

Electrical science, still new and but partially developed, is already of commanding importance to the State, since it enters more largely than any other science into industrial, commercial and domestic life; and it is certain to become still more closely identified with public interests by its application to new uses. Every thought of the future puts an emphasis upon this science that is given to no other. We have but to realize that all the water power of the State is being rapidly utilized for the development of electrical energy to see at once how vital is the relation between electrical science and public interests. This alone is enough to justify the State in fostering directly a study of this science on the same principle that has led to the establishment by State endowment at Cornell University of a State school of forestry, a State veterinary college and a State biological laboratory.

A second consideration is the increased legislation that will be demanded as electrical science progresses. Property must be protected and life safeguarded. For the enactment of right and necessary laws the State should have an independent and authoritative source of information free from the rivalries of commercial interests.

A third and most important consideration is the need of an official standardizing laboratory for electrical measuring instruments. No such laboratory exists to-day, and the demand for it increases every year.

If it is admitted, for the above reasons, that the State should be justified in establishing an electrical laboratory the question of location is still open. Why should Union College be chosen? Because the works of the General Electric Company, the largest in existence, make Schenectady the most natural place in the State, if not in the country, for an experimental station and for investigation and instruction in electrical science. Union College has the oldest engineering school connected with any college in America. It has already a fully organized department of electrical engineering. It is by its charter absolutely undenominational and, therefore, free from the Constitutional provision against State aid to sectarian institutions.

Pres't Glidden on the Erie Telephone System.

President Glidden, on returning from his Southern tour of inspection, says: "The State of Texas is very prosperous. Money is plentiful and banks are unable to loan their funds. Farmers have largely reduced their indebtedness and many mortgages have been paid off. Galveston is rapidly recovering from the effects of the flood, and at that point the company is now operating 1000 telephones, or 50 per cent of the number in operation at the time of the flood. Extensions in the Southwest are practically completed. The principal work to do is the connecting of new subscribers that apply

for service, and this can be done at a moderate outlay on account of a liberal excess of switchboard, underground and pole facilities already established at the principal points. We look forward to a very satisfactory and still larger increase of business in 1901.

"Cleveland is rapidly approaching a population of 450,000 people. Many new buildings are to be erected the coming spring. The success of steel and iron industries is the basis of Cleveland's continued prosperity. We are now operating 15,000 telephone subscribers in eight exchanges located in buildings, all owned and, with one exception, occupied exclusively by the company, all connected into the underground system. Our ninth exchange building will be completed by July 1, when we shall be able to take care of 25,000 subscribers."

More Views on the Berliner Microphone Decision.

In addition to the numerous opinions printed in these pages last week, as to the probable effects of the decision against the Berliner microphone patent, we now are able to publish the subjoined:

Mr. J. F. Hemenway, secretary and treasurer of the Ericsson Telephone Company, New York City, says: "Since before the incorporation of this company we noted with interest the advertisement in all the electrical papers by the American Bell Telephone Company of their patent, No. 463,569, which is the well known Berliner patent, issued Nov. 17, 1891, and covering all forms of microphone transmitters. The recent decision in the United States Circuit Court is of the greatest interest to all independent telephone people, meaning every one outside of the American Bell Telephone Company, for numerous reasons, one of which is that the persistent advertising by that company of the patent referred to has made capitalists and investors very cautious. While the independent telephone movement has gone forward by leaps and bounds, it would have increased much more rapidly and will hereafter. In our opinion, the effect will be to increase the confidence of those already interested in the independent telephone movement, whether the manufacturer, the jobber or the exchange owner. Through the success of those outside of the American Bell Company, many others will now become interested, with the result of stimulating the growth of the business. With the growth in the independent fields should come improvements and standardizing of apparatus with a coninued growth in favor of the best goods."

General Superintendent J. J. Nate, of the Standard Telephone & Electric Company, of Madison, Wis., writes us as follows: "We believe with the removal of this last bugaboo the telephone atmosphere has been considerably cleared up, and that its effect will be to bring into the work more capital and combinations for investment in exchange plants to be established in our larger cities. The Standard Telephone & Electric Company was the first in the field with a battery transmitter, the "Milde," an imported transmitter, manufactured in France, and before engaging in the business of manufacturing telephone apparatus, able counsel was secured, and the investigation of the Berliner patent, at that time the most important in question, was very vigorous and complete; in fact, costing many hundreds of dollars. The knowledge gained, however, enabled our company to guarantee its customers absolutely, and this has tended to strengthen our position in the independent field, coming as it did in the very first. Others who followed suit have found that with the growing work the general confidence of the public was secured and money invested quite fearlessly. About the most valuable feature of the Berliner patent to the Bell Company, in our opinion, is with regard to its bearing upon the receipts of the company in the matter of royalties from its licensees. Whether an appeal will be taken with a view to continuing the collections of these royalties remains to be seen. There has been, in our opinion, no more far-reaching, honest and consistent consideration of any patent in suit than that of the Berliner, in which Justice Brown has just rendered so decided an opinion."

The Indiana Mutual Telephone Association, consisting of representatives of the independent telephone companies throughout the State, held a meeting in Indianapolis on the 27th ult. The members anxiously awaited the decision in Boston. The regular meeting of the association is held during the summer, but it is customary for the members to get together during the winter, and the brief session was made the occasion of rejoicing. "There will be increased capital invested in telephones in Indiana now," said Vice-President Sherin. "Money will not be so timid, and it is only a matter of time until every nook and corner of the State will be connected, and 'talk will be cheap.'" About 100 members, representing 150 exchanges, were present. The officers are: President, John McGregor; vice-president, C. M. Zion; secretary, H. B. Gales.

We have the following from Mr. Warren Stoddard, on behalf of the Stoddard Telephone Construction Company, of Monroe, Mich.: "The recent decision in favor of the defendant in the well-known suit of the American Bell Telephone Company against the National Telephone Manufacturing Company, involves the interest of operators in the entire independent field. The extent of this interest will be better shown by pointing to the large and prosperous exchanges already established in St. Louis, Minneapolis, Cleveland, Columbus, Pittsburg and Rochester. The decision will, we think, tend to develop this industry to its fullest extent, and will relieve the apprehensions of capitalists so that it is only a question of time when all the cities, towns and villages will enjoy the luxuries of the telephone at the popular 'independent' rates."

Mr. T. M. Brush, secretary and treasurer of the Rawson Electric Company, telephone switchboard and apparatus manufacturers at Elyria, Ohio, writes us: "The great value of the decision from a public standpoint is the demonstration to the American people that no matter how large or supposedly powerful the influence, a case must have merit to win before our high and able courts. Commercially, the decision will, we suppose, have the effect of attracting timid capital to a most promising field, a field, in our judgment, destined soon to be in almost absolute control of well constructed, equipped and managed 'independent' telephone interests. Why? Because (and we say it with all feeling) Bell telephone interests never knew and do not now know how to run the telephone business. It is true, they have shown ability of a certain order in the handling of the legal questions and complications arising which enable them to make money in spite of other considerations. But all that is now past. A new era dawns in the telephone field, and a sorry one, in our judgment, for those who have wasted their opportunities. We are of those who believe that in a business like the telephone it is important to so conduct it as to have at least the good will of your own patrons as that also of the outside public where possible. Not having it, a business is indeed helpless when faced with active and intelligent competition. The old company has in its employ many bright, intelligent, hustling fellows, but what can they do in a town organized against them? They might as well be men of stone. This is the situation to-day. It is a situation that will continue to develop to the advantage of the independents until the finish."

Mr. W. F. Richardson, secretary of the National Telephone Equipment Company, of Detroit, Mich., says: "In my opinion, it is impossible to estimate the value of the Berliner decision to the independents. It means to the manufacturer that he will be unable to get equipment out fast enough to meet the demand. It means to the supply houses that they will be taxed to their utmost capacity. It means easy money for the promoter. It means success to the exchange owner. It means success and prosperity to all of us."

The Stromberg-Carlson Telephone Manufacturing Company, of Chicago, write us: "As to the recent decision of Judge Brown declaring the Berliner patent invalid, we are strongly of the opinion that the independent situation will show the greatest development and progress within the coming year or so known in the history of the industry. The decision will have a tendency to add confidence in the business with financiers and the investing public, and a number of important independent enterprises which have been in a dormant condition for the past year or so will now be taken up and developed, financed and completed, and not only the small cities of the United States will have independent telephone exchanges, but all of the larger ones as well. While it is to be expected that the Bell Company will still endeavor to harass the manufacturers of independent apparatus as much as possible, their threats at the same time will cut comparatively little figure in the situation in the future. We firmly believe that by this decision a new era for the independent telephone industry has been established, and that the prospects for future business have never been as bright in its history."

German Telegraph Service.

A recent dispatch from Berlin states that a number of prominent men in that city, representing commerce and industry, had a conference with the Secretary of Posts and Telegraphs regarding the frequent interruptions to the telegraph service to England. They declared that they would prefer to send their dispatches to London by way of New York, as they would reach their destination that way sooner than if sent direct from Berlin.

The Drawbacks of "Party" Telephone Lines.

We print below a copy of a letter addressed recently to a large telephone company by one of its subscribers on the "party line" plan. It sums up in somewhat graphic fashion the evils of that method:

Undersigned, a subscriber who was lured into putting a telephone into his house by your clever advertisements in the street cars, which admonish us "Don't walk! Talk!" would prefer to do the walking hereafter instead of putting his monumental patience to the daily test on account of the innumerable troubles attending a hapless telephone subscriber.

I have repeatedly complained to your chief operator of my utter inability to make use of this telephone 75 per cent of the time on account of an infernal woman on our party line, who believes that speech is silver; also believes in the divine ratio of silver 16 to 1; that is, 16 of her talks to our one. I cannot remember that I have ever gone to the telephone, either at my residence to call some one up or from my store to call up my house, but that I had my eardrums cracked with your "busy" signals. Or, if Heaven in its goodness was giving the dear woman a rest, some exchange annoyance or impudence would make me remember that I was getting all this pleasure for 16 cents a day.

The chief operator has always listened courteously to my complaint, and, as I suppose, has courteously shelved it, as I have never received any relief, and, to cap the climax, I was obliged to call up to Toledo, Ohio, by long-distance telephone on a family matter of importance, and after I got the party to the long-distance exchange in Toledo he was obliged to leave, as he had waited nearly an hour to get connection with me, but could not, as the line was "busy." As a result, instead of settling the matter right there and then, we were obliged to spend a night of anxiety, as, after that, we could not reach the party again.

I respectfully request that you place me on another circuit, or take off that loquacious woman, who is the wife of a well-known rag-time music publisher, and who seems to have her 5 o'clock teas and evening receptions by telephone, with utter disregard of other parties on the line.

Or, if you prefer, you may remove the telephone, refunding the unexpired premium on it, and I shall have peace on earth again.

Seeing by Electricity.

Mr. F. E. Kinsman, a well-known electrical inventor, writes as follows to the New York *Times:* My attention has been called to a short reference to an experiment by Prof. Dubois regarding the action of electric currents upon the human eye, and it may be interesting to mention some experiments I was accidentally led to make in this direction in 1878 in Chicago, which led me to believe that the solution of the problem of seeing by electricity would ultimately be found in electrically exciting the retina or nerves of the eye, independently of the external or light process with which nature has endowed a majority of the race through the medium of the external eye, and I believe that through this medium the blind will be made to see and appreciate the beauties of nature as they are now enabled to judge of forms and texture by the sense of touch.

My experiments have enabled me to produce to my own vision (with my eyes closed) the colors of the spectrum. This was done by varying the location of the electrodes of a voltaic battery, as related to the facial nerves, but I have not yet secured an instrument of sufficient delicacy and adaptability of adjustment as to attune the electric pulsations to the extreme delicacy of these nerves to which the application is necessary.

This application must be made through the medium of a facial mask with a "loud adjustment," as is commonly used by telephone operators, and must be quite as delicate in its operation as that wonderful instrument. Since it is all-important to impress the optic nerve with the same number and kind of impressions as are now produced by light waves, the transmitter for such an apparatus must necessarily be capable of receiving light waves as the telephone now receives sound waves and transposes them into electric pulsations, in which service the selenium battery will receive its fullest development.

I am led to make this matter public by the appearance of Prof. Dubois' article, and if possible hasten the day "when we shall see as we are seen," and suggest a line of investigation for others which, in my opinion, will soonest lead to the success I had hoped to meet with and thus give to the public a boon which my experience with the telephone has convinced me it would be but little short of criminal to patent.

CURRENT NEWS AND NOTES.

NO SUBMARINE BOATS FOR GERMANY.—Admiral von Tirpitz, Naval Secretary, declared in the Reichstag last week that he still adhered to his unfavorable opinion regarding submarine boats, and that the Naval Department would not construct any.

WAR TAXES.—The National Senate and House has concurred in the report on the War Revenue Reduction bill, which repeals various taxes, including that on telegraphs, estimated at a yield of $800,000 per year, and that on telephone long-distance messages, estimated at $315,000.

CONSOLIDATIONS IN MASSACHUSETTS.—The Massachusetts House rejected the Gilpatrick order for an investigation of the Massachusetts Electric Companies and accepted the Luce order which calls for a general investigation with a view to a revision of the anti-stock watering laws.

GOVERNMENT TELEGRAPHS.—The United States Senate, on motion of Mr. Butler, has adopted an amendment directing the Postmaster-General to make an investigation of the question of a postal telegraph system and report his findings to Congress, together with the probable cost of establishing the system.

LOCATING FAULTS IN UNDERGROUND ELECTRIC CABLES.—Methods of locating faults in underground electric cables was the subject of a paper read by Mr. H. W. Fisher before the December meeting of the Engineers' Society of Western Pennsylvania. All the methods in common use are quite fully described, and with respect to their application rather than their theory. Among the methods treated are testing with the magneto bell, telephone, voltmeter and galvanometer, and the Murray and Varley loop methods. Practical methods are also given for locating faults when the ordinary apparatus are not at hand.

ELECTRIC COMBINATION IN MONTREAL.—The Montreal capitalists, who are at the head of the big scheme for the amalgamation of the lighting and power companies of Montreal, under the name of the Montreal Lighting & Power Company, expect to have everything in shape to complete the deal by July next. It is freely admitted by the promoters that the absorption of the Lachine Rapids Hydraulic & Land Company is the most difficult part of the work in effecting this combine. The Lachine people are still outstanding, but it is stated that the negotiations, now in progress, will accomplish the amalgamation by the time above mentioned.

REVIVALS BY TELEPHONE.—At New Florence, Mo., Mr. Martin, an evangelist, of the Methodist Episcopal Church South, who is conducting a revival, has adopted the plan of preaching a sermon by telephone. Arrangements were made with the telephone company to place a telephone in such a position that every citizen in the county who had a telephone might hear it, as well as the congregation before which it was delivered. The sermon held the auditors glued to the receivers because of its force and eloquence. After the sermon, one man telephoned that he had been converted. This was announced from the pulpit. There appears to have been some difficulty since in determining his identity.

ALUMINUM HOUSES.—At the Buffalo Pan-American Exposition visitors will have the opportunity of seeing a small building made of aluminum. Niagara Falls is the principal aluminum manufacturing place in the world, and the white metal is a product of two principal factories located there, current being taken from both of the great power companies. This Pan-American structure, to be made of aluminum, will be located in the Manufacturers and Liberal Arts Building. In shape it will be octagonal, and it will be as large as can be built in a space 15 ft. square. The height will be about 22 ft., and it will be made of No. 24 sheet. The architecture will resemble the Spanish Renaissance, practically the same style adopted for the buildings of the great Exposition. Its lines will be graceful and there will be a beauty about it that is expected to win new admiration for aluminum.

IN THE PHILIPPINES.—A cable dispatch from Manila states that a wagon train and a detachment of the Signal Corps, together with six Macabebe scouts, were attacked by the insurgents about midway between the towns of Silang and Das Marinas, in Cavite Province. Three American were killed and two of the scouts were wounded, while one man is missing. Four horses and one mule were killed. Capt. Mair, with detachments of infantry and cavalry from Silang, arrived at the scene of the surprise too late to intercept the enemy's retreat.

ELECTROLYTIC METHOD OF MANUFACTURING PHOSPHORIC ACID.—A patent was granted March 5 to F. P. Denbergh on a process for the manufacture of phosphoric acid from apatite or other materials containing phosphorus, by means of heat and electrolysis. The phosphorus-containing material is crushed and mixed with sand or other material that will serve as a flux, and the whole placed in an electric furnace. The materials are then fused by the heat of the electric current and form a molten bath, and an electric current passing through this bath liberates phosphorus in an atmosphere containing an excess of oxygen, thus producing phosphorus oxides which are led off and condensed. To insure the hydration of the phosphorus oxides, steam or vapor is introduced into the furnace chamber.

DOGS AS ELECTROTHERAPEUTS.—The following letter appears in the New York *Evening Post:* A black cocker spaniel of my acquaintance has hit upon a pleasure so novel in canine society that it deserves recording. A young lady of the family to which he belongs once tested him by scuffing about the rugs of her home until she could give an electric spark of considerable snap, and then discharging it upon the nose of her pet, the spaniel. Not long after this abuse the dog was observed to roll upon the rugs, entirely of his own accord, and then to run to the brass bedsteads and obtain a spark. This he continues to do, and his own observations seem to have taught him that he must approach metal in order to receive the spark. In one room he runs to the bedstead; in another to the register, and as he licks his nose after the pricking of the spark he never fails to wag the remains of his tail, and his face assumes a decided expression of pleasure." There is no need to throw physic to the dogs when they run after it.

A NEW INSULATION FOR CONDUCTORS.—A patent was granted March 5 to C. P. Steinmetz on a method of insulating fine wire of the kind used in electrical measuring instruments and the like, with a structureless coating of cellulose. The wire is first passed through a solution of cellulose made by dissolving cotton wool in an ammoniacal solution of cupric oxide; the latter re-agent is prepared by first precipitating with caustic soda a solution of sulphate of copper to which salammoniac has been added, preserving the precipitate under water, and when the re-agent is new adding the hydrated cupric oxide to ammonia so long as it dissolves. The solution produces a deep blue mucilaginous liquid. After the wire has been passed through the solution it is allowed to dry, and is then passed through diluted hydrochloric acid in the proportion of one part of acid by weight to five parts of water, and is afterwards freely washed in pure water and dried. The dilute acid dissolves out the cupric ammonia and leaves the cellulose upon the wire in the form of a horny, brownish gray structureless coating. For larger wires or thicker films of cellulose, the coating may be impregnated with linseed oil or some other similar substance, to increase its toughness and flexibility.

ACCIDENTS AS A LIVELIHOOD.—A lawyer of this city who recently had business with the courts in the Borough of Brooklyn that occupied his time for several days, is quoted by the New York *Times* as follows: "It seems to me as if pretty nearly the whole of the population of Brooklyn is engaged in bringing suits against the Brooklyn Rapid Transit Company. Such as are not bringing suits already have them pending in some one of the courts. These suits are a source of steady income to a lot of attorneys who make a specialty of this practice, and I expect some would be on the verge of starvation but for them. It appeared to me as if people who had nothing else to do stood about near the tracks of some one of the trolley lines awaiting opportunities to be knocked over by the cars, and so secure the basis for a suit at law. Such a knock-down seems to be considered by the juries as worth about $7,500, and a fellow who can get a couple of such accidents in three years manages to get a very good living out of the experience without much inconvenience or bodily distress. What the effect of the recent setting aside of verdicts as exorbitant may be I cannot say, but the business up to this has been a good sort of thing to those who do not mind the nervous strain. One of my friends tells me that the doctors over there have changed their office hours from 9 to 11 in the morning to 9 to 10, so as to be in the courts in time to testify in these damage suits. This is said to have become far more profitable to them than the ordinary office practice, and a source of a very satisfactory income to such physicians as have offices conveniently near places where accidents are most likely to happen."

TWO-LIQUID REGENERATING PRIMARY BATTERY.—A reissue was made March 5 of a patent dated May 15, 1900, on a process of operating two-liquid primary batteries and regenerating the elements thereof. The invention properly speaking is for the use of the same liquid in the one compartment and then in the other of a two-liquid primary battery. In a two-liquid primary battery the depolarizer is destroyed by local causes if it is in contact with the zinc, but if the liquid is first used as a polarizer and when exhausted as such is then used as an excitant in the zinc compartment, the same liquid may be used for both purposes. The chief advantage claimed for this method is that it very greatly facilitates the regenerating of the liquids by electrical means, and many difficulties are thereby overcome, such as those due to diffusion of the two liquids if they are different. By the method described in the patent the normal amount of diffusion through the porous cup does very little harm, and the process of regeneration and subsequent use becomes a complete cycle, since for each regeneration the liquids are exactly the same, no matter how much diffusion there has been. It is claimed that a battery of this kind may be employed for transporting energy from a central station to the place of consumption, by means of a liquid which is not expended but merely acts like the plates of an ordinary secondary battery in storing electrical energy in the form of chemical energy. An advantage over the storage battery is that only the liquid need be transported from the place of consumption to the source of energy. Moreover, the amount of energy of one discharge is limited not by the size of the battery but by the amount of liquid at hand, which may be any amount desired. The difficulties heretofore met with in the regenerating of primary batteries have been due largely to the fact that, unlike the present method, the process was not completely cyclic.

ELECTROLYTIC INTERRUPTER.—A patent granted March 5 to Elihu Thomson describes an automatic interrupter of electric currents, designed particularly for employment with alternating current. The invention is based on the discovery that the Wehnelt type of interrupter may be successfully used with alternating currents by suitably varying the inductance or exposed area of the anode, or both, to effect an interruption of the circuit during successive pulses of alternating current of like sign. The instant of interruption depends upon the value of inductance, the voltage of the circuit and the area of the exposure of the anode surface, or upon the variation of the current density at that point. In carrying out the invention an adjustable inductance is placed in circuit with the anode and cathode of the interrupting device, to which circuit a moderate potential is supplied, such, for example, as that commonly employed in operating incandescent lamps. In this circuit is included the primary of an induction coil, the secondary of which is wound for step-up transformation, in which the rapid interruptions created by the interrupter may be rendered useful for operating high-frequency, high-potential devices. The induction coil or transformer in which the step-up transformation is effected may be used as the auxiliary variable inductance in circuit, by providing it with a movable core or other means of varying the inductance of its primary circuit. By this means the impulses of the alternating current of such a sign as to pass through the liquid conductor from the anode to the cathode, are suddenly interrupted, producing sharp fluctuations of e. m. f. in the translating circuit, and the alternating impulses of opposite sign pass through the apparatus without interruption, and are practically eliminated so far as any material reaction on the step-up transformer is concerned. By means of this arrangement an alternating current may be employed with equal efficiency with direct current for all purposes for which the Wehnelt interrupter has been proposed.

RELIGIOUS SERVICES BY TELEPHONE.—Owing to the prevalence of smallpox in Mount Pleasant, Mich., several of the churches were closed on Sunday a couple of weeks ago. The ministers hit, however, upon a plan to conduct services by telephone. The telephone company made proper connections to the houses of some of the members and the Baptist and Presbyterian ministers delivered 15-minute sermons over the wires.

AUTOMOBILE ENDURANCE TEST.—The Long Island Automobile Club is to hold in the near future a 100-mile endurance test. Mr. L. R. Adams is chairman of the committee, which has already formulated its rules. The maximum speed is 15 miles an hour; the minimum 8, where local ordinances require. The time unit for basis of computation is 500 minutes. The course must be covered in 12½ hours. There will be several awards. The entrance fee is $10. Motive power will be divided into classes, and there will be three judges in each.

ELECTRIC HEATING.—A patent was granted March 5 to Adolf Vogt, of Westminster, England, on the manufacture of electric heating appliances of high electrical resistance, capable of sustaining very high temperatures during long-continued use. The resistance is mainly composed of a non-conducting substance and a metal conductor. A mixture of a finely divided metal, such as nickle and of a non-conducting material such as kaolin is subjected in an atmosphere of hydrogen to only such a temperature as to cause all the oxidized metal particles to be reduced to the metallic state. The compound is then heated to about the welding temperature of the metal, whereby the non-conducting particles thereof are caused to assume a more or less vitreous and dense condition. In the specifications it is stated that this material is particularly applicable for effecting the preliminary heating of electrolytic conductors, and also for lighting cigars, for heating branding dies and a variety of similar purposes.

SUBMARINE BOATS IN NORWAY.—Admiral Börresen, Chief of the General Staff of the Norwegian Navy, has demanded through the medium of a supplementary budget the sum of $175,000 for the construction of a submarine ship in accordance with the system invented by the builder of the Holland. The Admiral, in his request, declares that "these vessels will have a speed of nine knots on the surface and seven knots under water. They will, too, if the hopes of their constructors are justified, be able to sink 10 meters under water and to remain continuously submerged during the space of four hours." Admiral Börresen says that he fully believes that the hopes of the constructors will be realized. He also regards these boats as admirably adapted to the needs of a country like Norway. The unique nature of the Norwegian coast, with its many fjords, would give them particularly effective opportunities for operating. He further anticipates that with one of these submarine vessels, which require only four men apiece to work them, it will be possible to inflict more destruction on an enemy than with a line of battleship manned by a crew of 300.

LIGHTNING ARRESTER.—Ordinarily when a double-pole lightning arrester is used, or two single-pole arresters connected to opposite branches of a circuit, a shunt circuit is formed from line to line, and when the lightning discharge passes it establishes a vapor between the discharge terminals, which may cause the arc to persist under the potential of the generator. This is especially true when metallic pieces are placed close together so as to produce a discharge path for the lightning at relatively low potentials in order to insure the protection of the insulating devices on the circuit. In a patent granted March 5 to Herbert C. Wirt on an application filed April 30, 1897, a means for obviating this objection is described. Metallic cylinders are used of sufficient mass to cause the heat generated by the lightning discharge to be directed away from the surface adjacent to the air-gap, the dischargers thereby being kept cool. In series with the lightning charge circuit, a rod of graphite or other non-inductive resistance is introduced to limit the flow through the lightning arrester circuit, thereby keeping down the heating and preserving the terminals at such a temperature that the arc once extinguished does not start up again.

DEATH OF PROF. FITZGERALD.—Prof. George Francis Fitzgerald died Feb. 21 at Dublin, Ireland. Prof. Fitzgerald was born 50 years ago in Dublin, and was a son of Dr. Fitzgerald, Bishop of Cork. We quote the following tribute to the eminent mathematician and physicist from Dr. Oliver Lodge, and printed in the London *Electrician:* "A good man he was if ever there was one, devoting himself to public work, free from all petty ambition, caring nothing for himself, throwing out his ideas right and left with splendid prodigality, rejoiced if they were absorbed and utilized by others. How quick he was to seize a point, how keen to criticize, to extend, to illuminate, a subject. Put near his elbow an abstruse paper, he would take it up casually, as another might a newspaper, and soon he would be absorbed and begin pencilling out calculations indicative of luminous ideas. See him at a British Association meeting of Section A. He was the life and soul of debate, he was always ready with some semi-paradoxical but wholly suggestive and stimulating idea. See him at that memorable meeting at Bath, when he brought forward and made known to the world the brilliant experimental discoveries of Hertz, discoveries which verified Fitzgerald's own suggestions and surmises. Hear him at that same Ψ and J and the propagation of electrostatic potential in time, and meeting when he was discussing with Lord Kelvin and others about the other outstanding difficulties in Maxwell's splendid work."

CAPILLARY ELECTROMETER FOR RELAY PURPOSES.—As is well known, the Lippmann electrometer consists of a glass tube drawn down to a capillary size at its lower end and filled with mercury. If this tube is made part of an electric circuit, any variation in potential at the terminals of the tube causes the mercury meniscus to move up and down, the extent of the movement of the meniscus measuring the variation in the potential. In a patent issued March 5 to Prof. A. C. Crehore and Capt. George O. Squier, the principle of this electrometer is applied to several new purposes. The space above the mercury is filled with a liquid such as oil and in the oil is located a receptacle, one or both sides of which are formed of metallic diaphragms. These diaphragms are insulated from each other and form terminals of the local circuit, and between them a suitable variable resistance is placed, such as carbon granules. Any variation in the elevation of the mercury in the tube will cause the diaphragms of the receptacle to be pressed forward, thereby decreasing the resistance through the granular carbon, and vice versa; by placing in the local circuit any device responsive to this variable resistance, the variations in the main circuit may be shown. The meniscus of the electrometer is very sensitive and rapid in its movements, and, therefore, the apparatus is well adapted for use as a receiver for submarine cables. Moreover, it may also be used for other purposes, since it responds quickly to changes of current; a deflection of the meniscus is proportional to difference of potential; it takes no current; the arrangement is dead-beat and responds to exceedingly small voltages.

LETTERS TO THE EDITORS.

Automobile Construction.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of March [illegible]s a letter from Mr. John C. Henry, of Denver, Colo., purporting to be a new departure in the construction of automobiles. While agreeing with Mr. Henry in his views respecting the construction of a vehicle on the lines indicated by the description and drawings given, the writer wishes to state that in point of novelty, Mr. Henry's construction is anticipated by a patent which was granted to Mr. F. A. La Roche, of this city, on June 28, 1900, record of which appeared in your "Record of Electrical Patents" in the following issue of your journal. The description of Mr. La Roche's combination motor vehicle or "multi-mobile," as he terms it, appeared in issue of the *Motor Age* of July 5, 1900, disclosing practically the same features which Mr. Henry describes.

NEW YORK CITY. PHILIP K. STERN.

The Electric Sign for Summoning Vehicles.

To the Editors of Electrical World and Engineer:

Sirs:—Upon reading your editorial remarks on illuminated electric signs in the March 9 issue, I was greatly pleased to note the encouraging future you predict for this twentieth-century advertising medium. Having acquainted myself of late with the various types of electric signs in the market, I fully appreciate your statement as to the shortcomings of the old stationary electric sign and the ease with which the sign can be made automatically changeable by means

of electricity. This is beautifully and almost perfectly exemplified by the methods which were thoroughly described and illustrated in your issue of March 2.

You further point out in your editorial the employment of electric signs for the purpose of summoning vehicles to the doors of the theater. You suggest a keyboard consisting of 8 rows having 10 numbers each. This, however, naturally implies the use of fixed letters lighted and extinguished at the will of the operator. For this purpose the Mason changeable letter you described is splendidly adapted, as by the use of three boxes or monograms all numbers up to 1000 may be formed. A keyboard consisting of only 3 rows of 10 keys each and a cable consisting of $3 \times 21 = 63$ wires, only need be installed. This small installation reduces the cost of operating such a system to a minimum, and should make this electrical calling system a very popular one; in fact, the "monogram" sign seems to solve this problem entirely, as it is in every way a "talking" electric sign.

MAX LOEWENTHAL.

NEW YORK CITY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCE.

Rotary Transformers.—COLLES.—The first part of an illustrated paper on "Rotary transformers, their history, theory and characteristics." It is a broad review of the subject. He first characterizes briefly the rectifier type, the inductorium type, the motor-generator type, the dynamometer type, and the rotary converter type, and gives illustrated descriptions of different devices and machines for continuous current only. The inductoriums of Boyle, Van Depoele, Waterhouse, Main, Edison and Jehl, the motor-generators of Van Depoele, Thomson, Henry, Rice, the dynamometers of Van Depoele, Walter and Thomson, the Thury method and the Scribner method of constant current to constant pressure transformation are described and illustrated.—*Jour. Frank. Inst.*, March.

LIGHTS AND LIGHTING.

The Welsbach Osmium Lamp and Electric Plants.—A long and detailed discussion of the results which may be expected from the introduction of the Welsbach osmium lamp for the profitable working of electric stations. Attention is first called to the well-known disadvantage that the present lighting station must be installed for maximum demand, while the lighting load is very irregular, and is a maximum only during a few evening hours. Storage batteries help to overcome this disadvantage somewhat. In alternating-current stations, however, it must be the aim of the managers to deliver during the daytime as much energy for power and traction purposes as possible. The smaller the ratio of the energy consumed for lighting to the energy consumed for traction and power purposes, the greater is the economy of working of the station. This ratio will evidently be diminished by the introduction of the osmium lamp, which consumes about 40 per cent of the power per candle of the ordinary incandescent lamp, so that from the introduction of the osmium lamp eventually a profit must result for the station. He considers the case of the Berlin Electric Works. The total capacity of the dynamos is 29,372 kw; the average load during the last year was 3291 kw, or 8.9 per cent of the total capacity, of which 1193 kw are the average lighting load. If, now, all the lamps were replaced by osmium lamps, and if as a result of this it is assumed that then only 50 per cent of the former electric energy is consumed for lighting, the total capacity of the works could be reduced to 19,825 kw and the average total load would be 13.6 per cent of the total capacity instead of 8.9 per cent, as above. In reality, the dynamos are available, and if we assume that the double number of lights would be connected on account of the higher economy, no more dynamos would be required and the works with the present capacity of 29,372 kw would be equivalent to a plant with a capacity of 48,467 kw supplying only Edison lamps. But this case is purely hypothetical. In practice, even with a very rapid introduction of the economical osmium lamp, the number of converted lights would not be doubled, but the following advantage would be obtained. Extensions of the plant which would become necessary for power and traction purposes, would be unnecessary. It is claimed that the power which would become available, as less power is required for lighting, would be utilized at once for power and traction purposes. In this case the whole capacity of the plant is again 29,372 kw, the average total load would be 12 per cent of the total capacity of the plant, against 8.9 per cent, as above. Finally, the case of a pure lighting plant is discussed. After the introduction of the osmium lamp the receipts would first decrease, but the connections of lamps would soon increase, just as has been the case with gas works after the introduction of the Welsbach gas lights. In smaller direct-current lighting plants, which are provided with storage batteries, the introduction of the osmium lamp would cause a saving of fuel, because the batteries have now virtually double the former size, as far as the lamp hours are concerned. It is finally pointed out that the introduction of the osmium lamp will probably also cause the introduction of storage batteries in the premises of the consumer. As the osmium lamp burns at 25 to 30 volts, only a third or fourth of the number of cells required for 110-volt lamps are necessary. The cells can then be charged at a low rate during the day, and the load factor of the electric station is improved. At the same time the important question is solved, how to produce the transformation of the voltage necessary for osmium lamps.—*Zeit. fuer Beleucht*, Feb. 20.

POWER.

Electricity vs. Steam for Station Auxiliaries.—An article in which the author says that one of the novel features of the Manhattan Railway system is the use of electric motors for operating the pumps. He considers the economy of this method as compared with the use of steam pumps. The latter will take about 3⅓ times as much steam as the electrically-driven pumps, but this steam can afterwards be used in the feed-water heaters and about 75 per cent of its energy saved in this way. In the case of the Manhattan station, the feed water is heated by economizers. He concludes that the steam-driven pumps are the more economical.—*St. R'y Jour.*, March 2, and Int. Ed., March.

REFERENCES.

Electricity in Mines.—An illustrated description of the installation in the coal mines de l'Esperance et Bonne Fortune, in Montegneelez-Liege, in Belgium. The power house contains three 200-kw three-phase generators. The motors used in the mines for pumping, ventilating, etc., are all induction motors.—*Revue de l'Elec.*, Feb. 15.

Electric Power in Workshops.—GEIPEL.—The first part of a paper on electrical power in British works. He discusses the advantages of electric driving under the following headings: Reduction of loss in shafting, saving of loss in steam pipes, saving of loss in engines, saving of water and stoves, saving of labor, increased output, facilities of working, facilities of extending, reduction of cost of repairs. —Lond. *Elec. Rev.*, Feb. 22.

Electric Power in Workshops.—A reprint of a report on electric driving in engineering workshops, especially electric driving of machine tools, presented to the Am. R'y Master Mechanics' Ass'n at the last annual meeting, as noticed before in the Digest. There is also a series of illustrations of some of the latest forms of machine shop application of electric driving in this country and abroad.—*Cassier's Mag.*, March.

Electric Cranes.—KOLBEN.—A long and very well illustrated article on electric cranes. He deals especially with mechanical details. For the gearing with electric cranes either spar and pinion is used, or a worm gearing combined with spur and pinion. He recommends standardizing worm gearing, as this is preferable for the constructor. He describes several modern types of cranes made by Kolben & Co.—*Elek. Zeit.*, Feb.

TRACTION.

Lisbon.—A very well illustrated article on the street railway system of Lisbon, Portugal. The city is very hilly. Mule cars have been used before, exclusively, the principal company having about 70 km. of track and 330 cars. When the change to electric traction was de-

cided upon one important subject discussed was the best method of preventing the competition of omnibuses which used to run on the tracks. It was decided to build a very narrow gauge for the electric cars (90 cm), as it would be almost impossible to build omnibuses to this narrow gauge. As the difference in temperature between night and day in Lisbon, especially in summer, is very large, considerable trouble has been experienced with expansion and contraction of the rails. They were originally laid with tight joints, but now a slight clearance is left between the ends of the rails, and they are clamped to the ties. The power station contains six engines of about 700 hp, three return boosters, one line booster, and one battery booster, all of which are driven by 500-volt motors. The car house has a capacity for 140 cars, and pit room for 107 cars. This pit construction was very expensive to build, and is a distinct departure from the usual American practice, where much less room is taken for car pits. The company is importing 195 new cars from America, all to be motor cars, the motors for these cars to be of a special type to fit the narrow gauge.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Boston Elevated Railway Company.—A very fully illustrated description of the new system. For some years Boston has been operating many of its trolley cars in a subway. The company is now building a system which is nearing completion, which includes an elevated structure about the city, and will be used in connection with the subway. The elevated trains will run into the subway by grades at each end, and both elevated and subway trains will transfer to the surface cars, the whole system being run under one management. There is a large, new power station near the center of the system, with two 2700-kw railway generators. There are at present 100 cars being equipped for this road. The cars are long, with double tracks, one truck only being used for the motors, which are two in number. The motor truck is slightly larger than the trailer truck. The third-rail system of collecting the current is to be employed, the shoes being suspended from cross beams between the two journal boxes by four links. The cars are to be run in trains by a system of multiple unit control, and no trailer cars are to be used. The power on each car approximates 300 hp, this large figure being necessitated by the rapid acceleration which it is intended to obtain in order to run on the high-speed schedule which has been mapped out. In order to provide safety for this speed a complete system of interlocking signals and switches is used and an extra high guard-rail placed at curves as well as safety stops, which set the brakes on a car passing them.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Portland.—An article giving some notes from Portland, Oregon. Owing to the distance of this company from the manufacturers in the East, much home-made material is used. The company builds its own cars, takes its own discarded motor fields, burns off the insulation and then insulates the wire anew, saving considerable money over new copper wire. The cars are dispatched by telephones. Sawdust is used as fuel in the power station.—*St. R'y Jour.*, March 2, and Int. Ed., March.

London.—A very fully illustrated description of the system of the United Tramway Company, which has been completely equipped, but has not yet been put in operation, owing to the opposition of the managers of the Kew Observatory. The power station contains three 750-hp engines, of which two are directly connected to direct-current generators, and one to a 500-kw three-phase generator. Many of the station auxiliaries are operated by electric motors. There are four sub-stations, each containing from two to three 250-kw rotary converters.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Germany.—An article giving notes from Germany. A description is given of the new power station at Leipzig, which contains three 420-hp condensing engines. The street railway company of Frankfort has installed some mail cars measuring 7.62 meters in length, and 1.8 meters in width. The cars are run between the main post office and the principal railway station. During January a convention of Prussian city authorities was held in Berlin, and arguments were made in favor of municipal control of tramways. The experience in Germany in this direction has been somewhat disastrous, especially in Dusseldorf. Some particulars of the results secured in that city are given. The city of Berlin has purchased two small electric lines about 16 km. in length for 10,000,000 marks, and will operate them.—*St. R'y Jour.*, Int. Ed., March.

Non-Paying Roads.—COOPER.—The fourth article on the question of how to make non-paying roads pay. He discusses income from transportation outside of the fare question, and speaks first of chartering cars. The charge for a car should amount to more than the regular fare for each individual of the party. This traffic seldom comes of itself, and must be created by a personal canvass. He also refers to advertising and paragraphs in the local newspapers. The carrying of freight can often be made remunerative, but this should be carried on a special car, and not on the regular cars, as it takes room, delays regular service, and interferes with the performance of the duties of the motorman and conductor. Freight cars can often be made out of old horse cars, when the freight is not too heavy. Milk is often a profitable item in a regular freight business. On long interurban cars the light freight can often be carried in a separate compartment at the end of the passenger car. The profit of carrying bicycles is a debatable question, but, as a rule, the writer does not recommend it. The leasing of some of the space in the cars for advertising can bring in an income, but usually takes considerable of the time of the manager.—*St. R'y Jour.*, March 2, and Int. Ed., March.

High-Speed Electric Railroading.—HUGHES.—An article giving some particulars of a road which he commenced to build between Chicago and St. Louis, where a speed of 75 to 100 miles per hour was planned. To avoid curvatures, it was decided not to pass through the large local towns, but reach them by spur lines. The current was to be transmitted at 10,000 volts, and the line was divided into 5-mile sections. Each section was to be alive only while the car or train was thereon, and was to be followed by a dead section, to prevent rear-end collisions. The trolley line was to be strung parallel with the rail, and not in catenaries. The trolley pole was to have a sliding contact with the trolley wire by means of a renewable carbon fuse. The motor car was shaped so as to reduce the resistance. The wheel base of the trucks was to be very long. The writer estimates that the road could be operated more cheaply than parallel steam roads. The project was abandoned later.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Spokane Snowplows.—An illustrated description. Owing to the power required to raise and lower the plows and flange diggers on each side, the company has put in a compressed air equipment for doing this work. The snowplows when in service are always run on the multiple position of the motors instead of the series, as there is less tendency of one pair of wheels to slip.—*St. R'y Jour.*, March 2, and Int. Ed., March.

REFERENCES.

Street Car Hoods.—PARTRIDGE.—A long and well illustrated article. The hood used on most street cars at present is of plain "clam shell" form; it is inherited from horse-car days, when all parts of a car had to be made light, but is generally satisfactory for electric service. Another form of hood is copied rather closely from steam practice.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Heavy Electric Railroading in Germany.—A digest of lectures by Bork, of Berlin, and Von Kando, of Buda Pest. The former gave some particulars of tests on the Wannseebahn, which show an estimated cost of 420 marks for each 100-car km. for electric service as against 480 marks for steam service. Von Kando referred to some experiments in Italy by Hungarian manufacturers with high potential transmission.—*St. R'y Jour.*, Int. Ed., March.

Conduit System in London.—A well illustrated description, with some critical remarks, on the proposed electric conduit for the London County Council's Tramways, a briefer description of which was noticed in the Digest, March 9.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Feb. 22; *Lightning*, Feb. 21.

Polyphase Railways.—PERKINS.—The second article of this illustrated serial on polyphase electric railways in Europe. He describes the Burgdorf-Thun railway.—*El'ty*, Feb. 27.

Railway Generators.—RYAN.—A well illustrated description in detail of the three-phase alternators of the Metropolitan St. R'y Company, of New York City.—*Sibley Jour.*, Feb.

Huddersfield.—A long and well illustrated description of the municipal railway system of Huddersfield. There are 15 miles of single track, being supplied from one station with direct current at 500 volts. There are two 375-kw generators.—Lond. *Elec. Eng.*, Feb. 15.

Current Supply to Long Railways.—RASCH.—A brief reply to the criticism of Sieber (Digest, Feb. 23). He remarks that his calculations refer to normal conditions only.—*Elek. Zeit.*, Feb. 7.

Motor Control.—SIEBER.—A longer abstract of his German article, giving a comparison of different methods of motor control (Digest, Feb. 23).—*St. R'y Jour.*, Int. Ed., March.

Automobile Trials.—An abstract of the judge's report on the

Chislehurst motor-car trials, which were noticed before in the Digest.—Lond. *Elec.*, Feb. 22; *Lightning*, Feb. 21.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCES.

St. Petersburg.—BAKER.—The first part of an illustrated description of the high-tension alternating-current station of St. Petersburg, which has a capacity of 7000 hp. There are seven steam-driven alternators, generating single-phase alternating currents at 3000 volts, with a frequency of 50.—*Lightning*, Feb. 21.

Capacity in Alternating-Current Working.—An account of the very long-continued discussion of Mordey's paper, which was abstracted in the Digest. Sparks, Fleming, Swinburne, Mather and Threlfall participated. Mordey's tests were criticized and the correctness of their results was questioned. Mordey replied that he was right.—Lond. *Elec., Elec. Eng.*, Feb. 22; abstracted in *Lightning*, Feb. 21. Lond. *Elec. Rev.*, Feb. 22; an article by Ayrton on the same subject in Lond. *Elec. Rev.*, Feb. 22.

Graphite Rheostat.—DIETZE.—An illustrated description of a starting rheostat used by Flohr for crane and elevator motors. The principal feature is the use of a powdered mixture of graphite and ordinary carbon. The variation of the resistance is gradual as in water rheostats, but there are no disadvantages due to evaporation or decomposition.—*Elek. Zeit.*, Feb. 14.

Cost Determinations in Isolated Electric Plants.—MOSES.—An article in which he urges the owners of isolated electric plants to keep detailed hourly records of the items of cost, and gives general suggestions how to make such a system of "log" records.—*Eng. Mag.*, March.

Switchboard.—WEEKS.—An illustrated article on the Niagara Falls Power Company's switchboards.—*Elec. Rev.*, March 2.

WIRES, WIRING AND CONDUITS.

Wiring Accessories.—An article in which is given a list of fittings, approved by the Manchester Corporations. It comprises switches for currents from 35 to 120 amperes, motor-starting switches, cut-outs, distribution boxes, ceiling roses, wall plugs, lamp-holder plugs, lamp holders and lamp-holder switches. The total number of fittings is 710, of which 289 are single-pole and 421 double-pole; 395 are for 100 volts, 300 for 200 volts and 15 for 400 volts.—Lond. *Elec. Rev.*, Feb. 15.

ELECTRO-PHYSICS AND MAGNETISM.

Stratification of Discharges.—STARK.—A paper in which he sketches the production of stratification as follows: As soon as the discharge has been started, the difference of velocity between the two kinds of ions produce a reduction of the ionization, and hence also of the force at the cathode. The negative particles acquire a great velocity and retain it for considerable distances owing to ionic shooting. The negative glow-light is a region of strong ionization, which reduces the velocity of the negative ions and produces an accumulation of them just beyond it. That accumulation acts as a secondary cathode, and produces similar phenomena.—*Phys. Zeit.*, Jan. 19; abstracted in Lond. *Elec.*, Feb. 1.

Thermoelectric Ores.—VAN AUBEL.—An account of an investigation of Abt's electromotive series of thermoelectric substances. In several instances this series was found to follow the law of thermoelectric force which applies approximately to the metals. But this approximation is by no means general, and a definite series cannot be made to include certain minerals.—*Ann. der Physik.*, No. 2; abstracted in Lond. *Elec.*, Feb. 22.

Magnetic Expansion of Iron and Nickel.—SHAW and LAWS.—The first part of an illustrated account of an experimental investigation of this subject. While in every previous research on this subject an optical lever method has been used for measuring minute changes of length, they use a different method of greater delicacy and greater range. They employ Shaw's "electric micrometer," which has a screw and set of levers moved at will by an experimenter; any movement made by the screw head is reduced by the joint action of the levers (whose arms are unequal), say, 1,000 times. The lever farthest from the screw carries a contact head of iridio platinum, and is arranged near a plate of iridio-platinum fixed to the body the amount of whose movement is to be measured. The contact head and plate, if they touch, complete an electric circuit which includes a telephone used by the experimenters. Another novelty in their measurements was that the current used for producing the magnetic field was measurd by the Crompton potentiometer method.—Lond. *Elec.*, Feb. 22.

Testing of Magnets.—KLEMENCIC.—An account of an investigation in which he found that the magnets which show the greatest permanency when exposed to shock, do not at all necessarily possess the greatest resisting power to other demagnetizing influences, but rather the contrary. Magnets should be tested with the same patience as standard cells, and their examination should occupy a corresponding interval of time. Experiments extending over a whole year showed that a magnet which in the first 27 days was placed near the end of the series in the order of permanency, advanced to the first place in the course of subsequent tests. This was largely due to its dimensions, and it appears that generally those magnets have a better chance in which the ratio of length to cross-section is great. The decrease in the moment is great within the first few days after magnetization, after which it becomes much slower. This indicates two causes of diminution, one of them being the "magnetic after-effect," and the other the structural changes connected with the hardness of the metal. In magnets which are not exposed to rough usage, as, for instance, in magnetometers, specimens with much coercive force, are more advantageous. Even soft iron, when preserved from shock, maintains its remanent magnetism for an extraordinary length of time.—*Ann. der Physik*, No. 2; abstracted in Lond. *Elec.*, Feb. 22.

ELECTRO-CHEMISTRY AND BATTERIES.

Gas Polarization in Lead Accumulators.—C. J. REED.—A paper in which he severely critizes the article of Nernst and Dolezalek abstracted in the Digest, June 9, 1900. The problem proposed by these authors was: Why can a lead accumulator with an aqueous electrolyte and an e. m. f. exceeding two volts exist, since the electrolyte is decomposed rapidly between platinum plates when the e. m. f. reaches 1.7 volts? The theory proposed by them was that the liberation of hydrogen from a given combination and condition does not require the absorption of a fixed quantity of energy, but that besides the free formation energy there is a variable quantity required, the value of which depends upon the occluding or absorbing capacity of an adjacent body. They assume that greater energy is required to liberate hydrogen in contact with lead than when in contact with platinum, because the platinum has a greater occluding capacity for hydrogen than lead has. Against this theory Reed makes the following statements, which leave their entire theory "not only without facts to stand on, but without any object or anomaly to explain": Hydrogen gas is evolved electrolytically in unlimited quantities from dilute sulphuric acid with electrodes of pure metallic lead when the e. m. f. is less than 0.5 volt. To prove this, he uses as an anode lead in a state of very minute division, as in a charged accumulator plate or in an electrolytically deposited lead tree. As a cathode, he uses a clean strip of sheet lead. The e. m. f. required to maintain a steady current between electrodes of pure metallic lead is less than 0.01 volt. This occurs without the agency or presence of lead sulphate in the solution or on the cathode. The e. m. f. required to charge an accumulator is in no way dependent upon or related to the evolution of hydrogen or oxygen on a lead electrode, nor is it dependent upon the occluding capacity of lead. He shows that Nernst and Dolezalek, while working with lead sulphate electrodes instead of pure lead electrodes, have not considered that the conversion of the lead into lead sulphate has produced an entirely new apparatus. He discusses the different electro-chemical actions which can occur in this new condition, and calculates the corresponding e. m. f.'s. When the electrodes of an electro-chemical system constitute also the electro-chemical re-agents, as in the case with the lead sulphate, lead peroxide and metallic lead of an accumulator, the decomposition tension of the intervening electrolyte is not necessarily a factor in determining the e. m. f. between the electrodes. It will usually be a factor if the constituents of the electrolyte are actually set free, but it cannot be a factor if none of the constituents of the electrolyte is liberated by the electro-chemical action, because the decomposition cannot then cause the absorption or evolution of the formation energy.—*Jour. Phys. Chem.*, Jan.

Electro-Chemical Units.—A summary of the electro-chemical units, suggested by Le Blanc, representing the German Electrochem. Soc'y, before the recent Paris Congress. Conductivity is to be expressed in ohm-centimeters and designated by *K*. A body has unit conductivity when a cylinder of the body of a square centimeter cross-section and 1 cm high has a resistance of 1 ohm. (This is evidently what is generally called specific conductivity.) Molecular conductivity is the conductivity, as defined before, divided by the number of gram-molecules dissolved in a cubic centimeter. The quantity of electricity necessary for the separation of a gram equiva-

lent (96,540 coulombs) is to be designated by *F*, after Faraday. Definition and units of the concentration equivalent, dilution equivalent, conductibility equivalent, electrolytic mobilities and velocities are also suggested.—*The Elec. Chem. and Met.*, Feb.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Measuring the Frequency.—WACHSMUTH.—A description of a very simple device for determining the frequency of an alternating current. It consists of a piece of watch spring clamped in a vice, and provided with a small square piece of white paper, stuck on by means of wax, as shown in the adjoining figure. When this is illuminated by a source fed by an alternating current and set vibrating, it will appear to stand still when the frequency of the current equals its own frequency of oscillation. The latter can be calculated easily from the thickness and the length, and in practice a graduation can easily be marked on the spring itself. A small correction must be added for the paper in the case of light springs. The method is very convenient, and can be used for frequencies up to 150 per second, beyond which the springs become too stiff.—*Ann. der Physik*, No. 2; abstracted in Lond. *Elec.*, Feb. 22.

FREQUENCY MEASURING.

Compensating for Voltmeters for the Voltage Drop in Long Feeders.—FIELD.—The first part of an illustrated paper read before the Glasgow section of the Brit. Inst. Elec. Eng. He describes a method whereby any voltmeter whatever may be compensated for the feeder drop of either a two, three or multiple wire system without necessitating constructional modifications of any kind, and, more than that, can be arranged to indicate the average voltage obtaining at any group of distant feeding points. The method depends on the insertion of a resistance at the staion end of the feeder whose resistance is some small fraction of the whole feeder resistance. "A high resistance is also placed between the bus-bars, and from a point on it some small fraction of the whole distance from, say, the positive bus-bars, connection is made to one voltmeter terminal, while the other is connected to the end of the feeder resistance rmote from the bus-bar." The ratio of this resistance to that of the feeder being properly chosen, the reading on the voltmeter will be a certain small fraction of the potential difference between the bus-bars, less the same fraction of the drop on the feeder. He discusses the following three cases: First, the measurement on the same instrument, not only of the actual voltage existing at various feeding points of a two-wire network, but also the average of the voltage at all the feeding points, or the average voltage at any desired group of feeding points of the network; second, the measurement of the individual feeding point voltages and the average voltage at any group of feeding points of a network on the three, five or other multiple-wire systems; third, the measurement by means of a low-tension electro-static multicellular voltmeter, of the voltage at the far end of a long single or polyphase power transmission line working at extra high-tension, and possibly possessing a comparatively large self-induction. In the present part the first case is discussed. The paper is illustrated by many diagrams.—Lond. *Elec.*, Feb. 22; the discussion which followed is given in *Lightning*, Feb. 21.

Measuring the Power of an Alternating-Current Circuit.—An illustrated description of a method of Langdon-Davies for measuring the true watts on an alternating-current circuit. Three ammeters and a voltmeter are required. One ammeter measures the current in the inductive circuit; the second measures the current in a non-inductive resistance, like a water rheostat, connected in parallel with the inductive circuit; the third measures the resultant current of the two branches together. The voltmeter is connected across the terminals. The power factor can be found by means of vector geometry, by a very simple geometrical construction, so that the power can easily be determined.—*Lightning*, Feb. 7. Some further notes on the method in *Lightning*, Feb. 14.

REFERENCES.

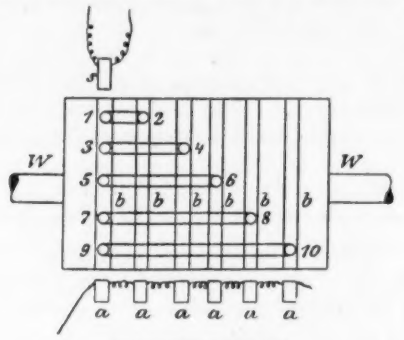
Thomson Bridge.—EDELMANN.—An illustrated description of three types of the Thomson bridge for small resistance.—*Elek. Zeit.*, Feb. 14.

Influence of Tramway Currents Upon Galvanometers.—CHEVALIER.—A brief paper read before the Internat. Soc'y of Electricians in Paris. He gives an account of the observations made in Bordeaux regarding the influence of neighboring electric tramways upon galvanometric measurements.—*Bull. de la Soc. Int. des Elec.*, Nov.

Clark Cell.—CARHART.—A summary of the various determinations of the e. m. f. of the Clark cell. The mean of the absolute determinations is 1.4333 volt at 15 degs. C.—*The Elec. Chem. and Met.*, Feb.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Relay.—WEST.—An illustrated paper read before the Electrotechnical Soc'y of Berlin, on Poulsen's telephonograph, which has been mentioned repeatedly in the Digest. He gives the principles of the instrument, describes the wire used, the ribbon types, its use for a telephonic newspaper, and Pedersen's device of using it for duplex telephony by using two electromagnets instead of one. Hagemann has applied the telegraphone from a telephone relay in the following way. As seen in the adjoining figure, there is a drum *W W*, upon which a number of closed steel ribbons *b b* are wound. The drum is revolved by a motor at high speed. The small "writing electromagnet" *s* is connected to the transmission line, and writes, so to speak, the arriving sound waves magnetically on the steel



TELEPHONE RELAY.

ribbon. The ribbon then passes along another similar electromagnet 1, in the coils of which currents are induced which are supplied to the writing electromagnet 2, so that the sound waves are recorded on the second ribbon *b* also. In the same way they are recorded on the other ribbons *b* by means of the third, fourth, etc., electromagnets. All ribbons, therefore, receive the same record. The energy required for generating the currents in the electromagnets 1, 3, 5, etc., is supplied from the motor which drives the drum. When all the ribbons have received the record they pass along the electromagnets *a a* which are connected in series. The e. m. f. at the terminals of this series is greater than the e. m. f. at the terminals of *s*. The terminals of the series *a* are connected with the next section of the transmission line. The effect of the device is to increase the amplitude of the waves. The apparatus is, however, still in the first experimental stages. There is also an editorial on the commercial prospects of Poulsen's instrument.—*Elek. Zeit.*, Feb. 21.

Propagation of Wireless Waves.—LAGRANGE.—An investigation of the part played by the earth in the propagation of the electric waves used in space telegraphy. He concludes that the earth behaves as a conductor and not as a dielectric. A coherer was buried in the ground 1 ft. deep, at a distance of some 100 yards from a 25-cm spark-gap provided with an air-wire 2-m long. Before the earth was covered over the coherer the latter responded well, and a relay actuated by it exploded a dynamite mine with the greatest ease. But when the wooden box containing the apparatus was covered with earth to the depth of 1 ft. all action upon the coherer and upon the mine ceased. He says nothing about the quality or the moisture of the soil. He believes the waves are partly absorbed and partly reflected by the coil, as they would be by a conductor, and points out that the explosion of underground mines cannot be carried out with the apparatus described.—*Comptes Rendus*, Jan. 28; abstracted in Lond. *Elec.*, Feb. 22.

Application of the Manometric Flame to the Telephone.—AUSTIN.—An illustrated description of a method of making visible the sound waves produced in a telephone, by using a manometric flame and photographing the records. The manometrical telephone is useful for lecture-room demonstrations of the telephone diaphragm, and of the undulations of an alternating current. In connection with a second manometric flame, actuated by a tuning fork of known

period, it becomes a frequency teller. It may also be used in studying the distortions in sounds, produced by telephone transmission, and offers a convenient method of comparing small alternating electromotive forces.—*Phys. Rev.*, Feb.

Wireless Telegraphy.—FLEMING.—An abstract of a paper on "The Marconi system of wireless telegraphy as applied to lightships and lighthouses." An improvement which Marconi has made, is that instead of connecting a sensitive tube with a long aerial wire, he introduced a type of tube, known as a "jigger," which enabled him to conduct his experiments over a greater distance and to get rid of disturbances due to atmospheric electricity. He has recently succeeded in establishing perfect communication between St. Catherine's and the Lizard, 200 miles apart; he can send two messages each way at the same time.—Lond. *Elec. Rev.*, Feb. 22.

MISCELLANEOUS.

Training of Electrical Engineers.—NICOLSON.—A long abstract of a paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. He first speaks on the importance of laboratory work in engineering schools; their purpose is to extend scientific knowledge by providing more experimental data, and to show the student the scope, value and limitation of the theories he has studied in the classroom. He recommends that the laboratory should contain machines and instruments of the newest types procurable, which may serve as object lessons on the general trend of electrical engineering design. He strongly advocates, that, after leaving school, the student who intends to become an electrical engineer, should first spend at least two years in the workshops of a mechanical engineer and then enter an engineering college to study there for not less than three years. The particulars of this study are discussed in detail. The paper is commented upon in some editorial notes.—Lond. *Elec. Rev. and Elec.*, Feb. 22.

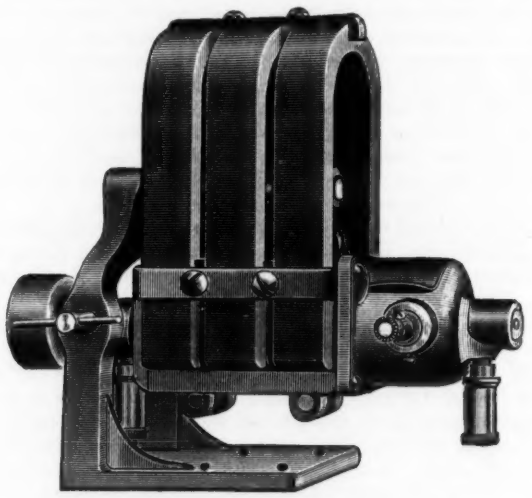
Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Niagara Falls, N. Y., May 21-23, 1901.

Gas Engine Igniter.

The igniter illustrated herewith is of the magneto type and manufactured by the Carlisle & Finch Company, Cincinnati, Ohio. It is



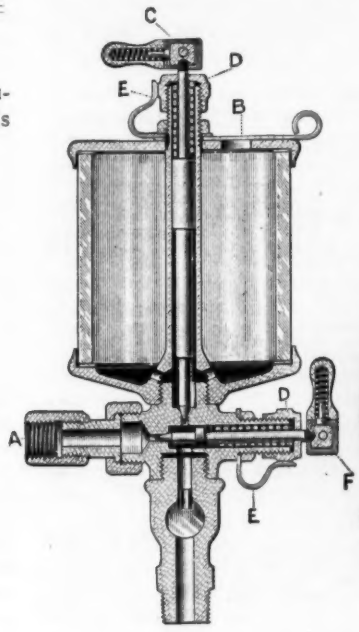
GAS ENGINE IGNITER.

said to differ from other machines of this class in that it has a toothed laminated armature, and does not require to be run at a high speed. It will produce a good spark when running at 1100 r. p. m.

The magnets are made of special steel, and are said to be much stronger magnetically than it has been possible to make magnets heretofore. The special belt tightener obviates trouble due to loose belts; a turn or two of a thumbscrew rocks the magneto just enough to tighten the belt and a small lock clamp holds it from slacking off again. Among the good features of this machine to which attention is called by the company, are carbon brushes, copper commutators and self-oiling bearings.

Pressure Oil Cup.

The pressure oil cup shown in the illustration given below possesses some improvements, to which the Lunkenheimer Company, Cincinnati, Ohio, calls attention. The glass reservoir is not under any pressure whatever, but instead the oil supply is piped through the union *A* in the base, the opening of which into the oil duct leading to the bearing is controlled by an oil-regulating valve, *F*. The auxiliary supply is regulated by the oil valve, *C*. With this cup it is said to be easy to regulate the supply of oil under pressure at all times. When it is desired to cut off the supply, the valve, *F*, is turned down and it will then act as an indicator, showing from a distance that the supply is shut off. The regulation of this valve is very easily and simply effected, and when once the valve is set it is not disturbed by the jarring of the machinery. The feed can be turned on or off by simply raising or lowering the cam lever, *F*. The auxiliary oiler, which is intended to be used in case the pressure supply should be discontinued or cut off, consists of the Company's "Sentinel" oil cup, the feeding of the oil being regulated by the cam lever, *C*, in the same manner as with the pressure supply. The auxiliary oiler has a large slide filler, *B*, which dispenses with the use of screw plugs. All the parts of the cup are made of cast brass.

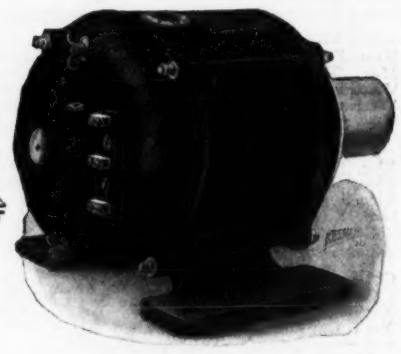


PRESSURE OIL CUP.

Direct-Current Power Motors.

The accompanying illustration shows a new direct-current power motor being put on the market by the Emerson Electric Manufacturing Company, St. Louis, Mo., which has several new features. It is made with six poles, the field iron being made of punched sheets or laminated in the same manner as in alternating-current motors. This field, it is said, gives all of the advantages derived from an ordinary multi-polar construction, one of the most important of these being the fact that all magnetic circuits and all-wire circuits are much shorter than in the bi-polar construction.

In both the mechanical and electrical design of these motors, the company is following the construction of large engine-type generators. The armature and commutator are mounted upon the same casting, thus allowing the shaft to be removed without disturbing the relative positions of the armature and commutator. The armature is laminated, no band wire being used, and a straight line type of brush holder, which is claimed to be both simple and reliable, has been adopted. The motors are entirely enclosed and are, therefore, suitable for operation in places where it would be undesirable to expose the commutator and brush.



DIRECT-CURRENT MOTOR.

The commutator end of the motor frame is provided with two small covers, which, upon being removed, give access to the brushes and brush holders. In order to permit of visual inspection without removing these covers, a peephole, covered with mica, is provided in the top of the motor, so that any excessive sparking can be detected without opening the cover of the machine. Every motor is tested before leaving the factory, each one being required to carry 50 per cent above its actual rated capacity.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 2 per cent nominally. Time money during the week was in good demand at rates ranging from 3 to 3¼ per cent for 60 days to 4 months, and 3½ per cent for 5 and 6 months. Mercantile paper is quoted at 3½@4 per cent for 60 to 90 days' endorsements, 4@4½ per cent for choice 4 to 6 months' single names; 5 per cent for others. In the stock market the activity and strength in railroad and miscellaneous shares was somewhat checked by a firmer tendency in money. The so-called "steel deal" was the topic which received the greatest amount of attention in Wall Street. Various special shares also secured prominence, the most conspicuous movement of this kind being in Amalgamated Copper, which rose from 95 to 103⅜ on reports as to the copper mining and the legislative situation in Montana, where the company's chief interests are centred. The New York local gas stocks also had large advances on favorable intimations, and some bullish interest was displayed in traction securities. In the traction list Brooklyn Rapid Transit showed the greatest activity, closing with a net gain of 3⅞ points. The total number of shares sold was 108,685, which shows a close approach to the activity of the week ending Feb. 9. Metropolitan Street Railway Company was also actively dealt in, 45,000 shares having changed hands. The highest price reached was 166¾ and the lowest 161, the stock closing with a net gain of 4 points. In the electrical stocks General Electric was unusually lively, closing with a net gain of 5 points, the highest price being 216½, and the lowest 211½. The total number of shares sold was 13,925, which is about three times that of the preceding week. There was a revival of interest in Western Union during the week, which resulted in higher prices. The speculation, however, soon subsided and the stock closed at 87⅞, 1 point higher than the close of the previous week. The total number of shares sold was 30,970. American District Telegraph records a net loss of 1 point, and American Telegraph & Cable ¾. In the list of outside securities nothing of particular importance transpired, and the changes in quotations of electrics were generally fractional. Electric Boat, both common and preferred, closed with a net loss of 2 points each. Electrical Lead Reduction Company stock was dealt in on the "Curb" during the week for the first time. Following are the closing quotations at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Mar. 2.	Mar 9.		Mar. 2.	Mar. 9.
General Electric	210	215	Elec. Veh	—	14
Brooklyn Rap. Tran	74¾	78⅝	Elec. Veh., pfd	30	—
Met. St. Ry	161	165	Gen. Car	2¼	2¼
Am. Tel. & C	94	95	Ill. Elec. Veh. Tran	⅞	1
West. Un. Tel	86⅞	87⅞	Hud. Riv. Tel	120	120
Am. Dist. Tel	37	36	N. E. Elec. Veh. Tran	2¾	3
Com. Cable	160	—	N. Y. Elec. Veh. Tran	3¾	4
Elec. Boat	27	25	Tel. & Tel. Co. of Am	4	4¼
Elec. Boat, pfd	52	50	N. Y. & N. J. Tel	180	180

BOSTON.

	Mar. 2.	Mar 9.		Mar. 2.	Mar. 9.
New Eng. Tel	135	135	Erie Tel	50	51
Mex. Tel	2⅞	*2⅞	Gen. Elec., pfd	—	—
Westing. Elec	—	60	Am. Tel. & Tel	158⅞	160
Westing. Elec., pfd	—	—	Boston Elec. Light	—	—

PHILADELPHIA.

	Mar. 2.	Mar 9.		Mar. 2.	Mar. 9.
Elec. Stor. Bat	75½	74	Phil. Elec	6¼	6⅛
Elec. Stor. Bat., pfd	75½	76	Pa. Elec. Veh	1½	1½
Elec. Co. of Am	7¾	8½	Pa. Elec. Veh., pfd	1	1
Gen. Elec. Auto	—	—	Am. Rys	33½	34½

CHICAGO.

	Mar. 2.	Mar 9.		Mar. 2.	Mar. 9.
Chicago Edison	150	150	Chicago Telep. Co	260	260
Chic. City Ry	255	260	Union Traction	14	15½
Nat'l Carbon	16	16	Union Traction, pfd	56	56
Nat'l Carbon, pfd	82	83	Northwest. Elev. Com	36	35½

*Asked.

ELECTRICAL LEAD.—The Electrical Lead Reduction Company has a new process of converting lead ore—galena—into various lead compounds by electrical reduction. It is stated that it has no competition in its line, being the first concern in the United States to make lead or lead compounds by electrical reduction. Its factory is at Niagara Falls, and the ore is procured at Joplin, Mo. The company also makes pure sulphuric acid as a by-product. Dividends on the preferred stock are cumulative at 7 per cent. Among the original subscribers and present stockholders are Robert H. Sayre, president of the Bethlehem Iron Works; Samuel R. Shipley, president of the Provident Life and Trust Company of Philadelphia; Alfred Skitt, second vice-president of the Manhattan Railway Company, and Henry G. Morris, of Morris, Tasker & Company. Reference to the system was made recently in these pages.

ELECTRIC STORAGE BATTERY.—The net earnings of $1,317,865 reported by the Electric Storage Battery Company for the year 1900 are 7½ per cent on nearly $17,000,000 capital stock outstanding, of which amount $5,000,000 is preferred. The $460,000 above the 5 per cent dividends on each class of stock, carried to the credit of surplus account, is being used as working capital in the business. While in 1899 the profits included profits from Electric Vehicle investments, the profits for 1900 are stated to represent entirely the regular receipts from the storage battery business, which is steadily expanding. The company has paid off its $400,000 mortgage and $300,000 in accumulated dividends in the last two years, and the way is now clear for continuing dividends and making increase in the earnings for the stock.

GENERAL ELECTRIC.—This stock was very active on Monday last, breaking sharply at one time from 216½ to 211, and later rallying to 214. The decline was on the announcement that the directors of the company had declared only the regular quarterly dividend of 2 per cent. In the preceding quarter an extra dividend of 1 per cent had been declared, and it was expected that something extra would be given the stockholders this quarter. The rally was on the announcement that in the suit of the company against the Lorain Steel Company a favorable court decision had been handed down as to the use of the overhead trolley.

UNION TRACTION.—The Union Traction Company, incorporated recently in New Jersey with an authorized capital of $1,000,000, has increased its capital to $15,000,000, of which one-half is preferred, with 5 per cent cumulative dividends. The papers were signed by Ashley W. Cole of New York, president, and L. B. Grant of Brooklyn, secretary. The purposes for which the company is incorporated are to construct bridges, buildings, machinery, engines, cars and other railway equipments, water works, gas works and electric light and power works. It is expected to buy into control of New York traction properties.

DIVIDENDS.—The Philadelphia Traction directors declared a regular semi-annual dividend of $2 per share, payable April 1. A dividend of 6 per cent on the preferred and 1 per cent on the common stock of the Hall Signal Company has been declared, payable April 1. The General Electric Company has declared a quarterly dividend of 2 per cent, payable April 15. The American Steel & Wire Company has declared a quarterly dividend of 1¾ per cent on the preferred stock and 1¼ per cent on the common stock, payable April 2.

DENVER TROLLEYS.—At the annual meeting of stockholders of Denver City Tramway, directors were re-elected. President Curtis' report showed gross receipts for the year of $1,302,289, the largest for any time since 1892. The entire floating debt of the company was paid off during the year, and the company has now no other indebtedness outstanding than its bonds. Improvements planned for the present year include a new central power house.

HUDSON RIVER TELEPHONE.—The Hudson River Telephone Company, which operates Bell exchanges in Albany and the cities and villages of the Hudson River and Mohawk Valleys and of Northeastern and Southern New York and Northern Pennsylvania, has filed with the Secretary of State a certificate of increase of capital stock from $3,000,000 to $4,000,000.

MR. E. F. KIRKPATRICK, Western manager for McRoy Clay Works, Chicago, has just closed a contract with the Keystone Telephone Company, of Philadelphia, Pa., for 4,000,000 ft. of the McRoy conduit. This is the largest single order that has ever been placed in the United States for conduits, and Mr. McRoy has secured some pretty heavy ones already.

UNION SWITCH & SIGNAL.—The annual report of the Union Switch & Signal Company showed that the profits of the company were $390,000, equivalent to about 26 per cent on the entire capitalization. This is the best showing ever made by the company.

COMMERCIAL CABLE.—A regular quarterly dividend of 1¾ per cent will be paid April 1, 1901, to stockholders of record on March 20, 1901.

Commercial Intelligence.

THE WEEK IN TRADE.—The mercantile agencies report that trade as a whole continues quite cheerful. Most lines of distributive spring trade are active, and the leading industries are actively employed. Some "soft spots" are still in evidence in the textile industries, particularly in cotton goods, and raw cotton has again sagged heavily. The cereals, too, lack snap. In the iron and steel trade buoyancy existed. Finished products shared the strength of the general market, and plates are bringing $2 a ton above the schedule, while

the rail, bar and structural mills are quite busy. Preliminary February returns of gross railway earnings point to an aggregate gain of 10 per cent over the same month last year. Business failures for the week, as reported by *Bradstreet's*, numbered 208, as against 177 the week previous, and 189 in the same week a year ago. While the failures last week were more numerous than they were a year ago, they were much less costly. There is no change in copper prices, the situation, however, remaining firm. Business was quiet and there was scarcely and inquiry for export. Lake is quoted at 17c. and electrolytic at 16⅝c.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week just ended, Feb. 28: Antwerp—5 packages motors, $700; 4 packages motor vehicles, $850; 51 packages electrical machinery, $5,554. British Australia—72 packages electrical material, $4,646; 22 packages electrical machinery, $1,575. British Possessions in Africa—110 packages electrical material, $5,056. Belfast—1 cable, $125. Bremen—2 packages electrical material, $146. Bilbao—1 package electrical machinery, $23. Brazil—8 packages electrical material, $597. British West Indies—66 packages electrical material, $563. Central America—25 packages electrical material, $667. Cuba—67 packages electrical material, $2,072. Ecuador—13 packages electrical machinery, $1,300; 1 package electrical material, $20. Glasgow—62 packages electrical material, $7,534; 19 packages electrical machinery, $1,500; 69 reels cable, $24,763; 2 cases auto vehicles, $2,500. Hull—45 packages electrical machinery, $8,462. Havre—20 packages electrical material, $2,754. Hamburg—4 packages electrical machinery, $851; 99 cases electrical material, $8,959. Liverpool—39 packages electrical machinery, $5,284; 36 packages electrical material, $8,069. London—7 packages electrical machinery, $1,505; 67 packages electrical material, $9,935. Munich—1 case electrical machinery, $500. Mexico—460 cases electrical material, $5,246; 11 cases electrical machinery, $5,228. Milan—36 packages electrical material, $3,119. Newcastle—8 cases electrical machinery, $829. Naples—1 case electrical material, $512. Nova Scotia—3 packages electrical material, $274. Newfoundland—7 packages electrical material, $683. Peru—61 packages electrical material, $5,335. Reval—3 cases electrical material, $780. Ramsgate—1 case electrical material, $100. Santo Domingo—23 packages electrical material, $389. U. S. Colombia—2 packages electrical material, $60. Venezuela—36 packages electrical material, $1,306.

RUSSIAN TRADE.—President Vintschger, of Markt & Co., Limited, exporters of hardware, machinery, etc., to Russia, contends that the general trade of America with the Czar's country has been greatly underestimated, because of the peculiar conditions under which a great part of American goods find their way to that country. A considerable volume of this trade is set down to the credit of Germany because the shipments are made to German ports and to German merchants, and by the latter resold and reshipped to the Russians, who ask generally from six months to a year. With Russia American trade is conducted through central European houses, who better understand conditions there. American exporters are quick and businesslike, and want quick returns on their capital. They sell on a cash basis to German and English houses, and these latter resell to Russians, on longer time payments. It is these indirect exports that Russian trade gets no credit for at all, and yet they amount to millions of dollars annually, making the actual loss of trade to the United States by the present situation far beyond any estimate that has yet been made.

THE YORKVILLE INDEPENDENT HYGEIA ICE COMPANY, which is building a huge ice-making plant in East Eighty-second Street, New York City, has closed a contract with the Frick Company for the supply of two ice-making machines having a combined daily capacity of 250 tons. Two large Corliss engines to drive the machinery will also be built at the Waynesboro (Pa.) works of the Frick Company. The boiler contract, which calls for three boilers of 400 horse-power each, has been secured by the Stirling Company, of Chicago. The value of the above-mentioned contracts is close on $150,000. The plant is to be lighted by electricity. A 25-kw generator, switchboard and other accessories will be furnished by the Milwaukee Electric Company, while the Frank M. Pierce Engineering Company, of New York City, is to supply an 8x10 Erie Ball engine.

BULLOCK ORDERS.—The advance department of the Bullock Electrical Manufacturing Company, of Cincinnati, Ohio, reports the continuance of an unusual demand for medium-size machines, particularly for power. Among the orders of the past week were: One 20-hy motor for the Baltimore *Star* (the fourth order); one 100-kw engine type generator for the Lexington & Boston Railway Company, Lexington, Mass.; one 22½-kw generator for the Cedartown Cotton Mills, Cedartown, Ga.; one 50-kw engine type generator for the "Schuyler" apartment house in New York City; one 750-kw, 180 r. p. m., two-phase alternator for M. T. Davis, Sheik's Island, Canada; one 50-kw engine type generator for the Parkersburg Iron & Steel Company, Parkersburg, W. Va.; and for the Anheuser-Busch Brewing Company, St. Louis, five 30-hp type M. N. motors, and one each 10 and 20-hp type H motors.

J. HOLT GATES & COMPANY, Monadnock Building, Chicago, has just installed a 250-hp electric power plant for the Grower Building, Chicago, in connection with Vilter-Corliss engine. A great many of the electrical people of Chicago will occupy this building, and it will be a representative plant. This firm has been very busy this winter. It has also furnished a plant to the village of Blue Island, Ill., comprising a 2500-light Warren inductor alternator with a new style, 4-valve, Ideal self-oiling engine. The series alternating arc system, made by the Manhattan General Construction Company, consisting of two 25-light regulators and two 15-kw raising transformers, was also installed, as a large number of 50-cp incandescent lamps are run in series with the arc lamps, and a fine switchboard.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports the following from recently received orders: One 250-kw three-bearing, slow speed, belted type generator for the Laclede Gas Light Company, of St. Louis, a duplicate of the machine sold to the same concern four months ago; one 80-kw generator for the St. Louis Coffin Company; one 80-kw belted generator for the Mannering Electric Light Company, of Mannering, Iowa; two 60-kw belted generators for the Carrolton Electric Company, Carrolton, Iowa; and an unusually large number of orders for small machines. Mr. Jacobs, of this concern reports increasing inquiry and business in the line of municipal plants.

THE MARINETTE IRON WORKS, of Marinette, Wis., through Mr. A. L. Hamilton, the secretary, write us: "We are making extensive improvements in our plant, building a 120-ft. addition to the machine shop, installing an electric crane there and large boring mills. We are also installing a Taylor gas producer, manufactured by R. D. Wood & Company, of Philadelphia. In connection therewith we are putting in our own engines throughout the plant. We have recently built a large pattern shop, introducing modern machinery to aid us in conjunction with our gas engines. We are overcrowded with orders for engines, not only from the United States, but also from several foreign countries."

NEBRASKA POWER.—The Niobrara Irrigation & Power Company has been organized with a capital of $100,000 to develop an extensive water power from the Niobrara River. Mr. Arnold C. Koenig, Associate Member A. S. C. E., of Grand Island, Neb., has been engaged as chief engineer. The dam will be about 2000 ft. in length and the canal, 7 miles long, will be designed to furnish sufficient water to develop 1500 horse-power on the turbine shafts, with provisions for future enlargement. The power will be transmitted electrically to points in the surrounding territory, including 35 miles of new electric railway.

RUSSELL-TOMLINSON ELECTRIC COMPANY.—A reorganization in the Russell-Tomlinson Electric Company, of Milford, Conn., has resulted in the election of Mr. N. Burton Rogers, Danbury, Conn., as secretary and treasurer, and Arthur J. Baldwin of New York City vice-president. W. E. Russell remains president, as before. This company has made a great success of selling telephone instruments at low price, and has gained the reputation of turning out very good products.

FUEL ECONOMIZERS.—The Rhode Island Suburban Railway of Providence, R. I., has contracted, through the New England office, at 53 State Street, Boston, Mass., of the Green Fuel Economizer Company, for their equipment of heaters to 7000 horse-power of water-tube boilers. The Cambridge Electric Light Company, Cambridge, Mass., will have a Green Economizer in the new modern power station they are building.

FORT WAYNE APPARATUS.—The Cincinnati office of the Fort Wayne Electric Works reports the sale of a 200-kw high-frequency Fort Wayne alternator to the city of Greenfield, Ohio, an increase of a plant established about six years ago. At the same time the city purchased a 500-hp Greenwald engine and a Laidlaw-Dunn-Gordon pump.

ORDERS FOR BALL ENGINES.—The Lake Erie Iron Company, Cleveland, Ohio, has recently installed an electric power plant, the engine being 175 horse-power, self-oiling type, built by the Ball Engine Company, Erie, Pa. The Northern Pacific Railway Company has also recently purchased from the Ball Engine Company a 150-hp self-oiling engine for electrical purposes.

IRISH TROLLEYS.—The Kerry County Council has approved the scheme of the Irish Electric Railway Company to construct an electric railroad between Castletownbere and Kenmare, Ireland. The construction of the road involves $3,500,000, and bids for equipment and material will be called for early in April next.

BIDS are being received by the Imperial Wheel Company, of Flint, Mich., for dynamos of 125 to 250 kilowatts; motors, 200 to 400 horse-power; engine capacity of 400 horse-power; four 150-hp water tube boilers and electric wiring.

BALDWIN LOCOMOTIVE WORKS, of Philadelphia, reported that they built 48 electric locomotives during 1900. Their total output was 1217 engines, of which 363 were exported.

General News.

THE TELEPHONE.

DUBLIN, GA.—Clark Grier has petitioned the city for authority to establish an exchange here.

LEESVILLE, LA.—The Cumberland Telephone Company has applied for a telephone franchise.

HARRIMAN, TENN.—The Cumberland Telephone Company has purchased the Harriman Exchange.

NEW DECATUR, ALA.—A company is being organized to establish an independent telephone system.

LIMAVILLE, OHIO.—The Stark County Telephone Company has obtained a franchise for a local exchange.

NORTH LEWISBURG, OHIO.—The people of this place are agitating for an independent telephone exchange.

SALT LAKE CITY, UTAH.—The Home Telephone Company has asked for a franchise to establish a system in Ogden.

DAVILLA, TEX.—The Davilla Telephone & Improvement Company has been incorporated with a capital stock of $10,000.

SOUTH BEND, IND.—The companies in this city using overhead wires have agreed to place all their wires underground.

DURANT, I. T.—The Denison & Choctaw Telephone Company has sold its line and exchange here to Capt. Hughes, of Bonham.

KNOXVILLE, TENN.—The People's Telephone & Telegraph Company is considering the issuance of improvement and extension bonds.

PENSACOLA, FLA.—J. L. Hayes, of Tallahassee, and associates, have applied for a franchise to establish an independent telephone system here.

COLUMBUS, OHIO.—The Franklin County Telephone Company has just opened exchanges of 100 lines each at Canal Winchester and Westerville.

SALEM, OHIO.—The Columbiana County Telephone Company is installing a branch at New Springfield. Free service will be given throughout the county.

ALBANY, N. Y.—The Queen City Telephone Company was incorporated recently with a capital stock of $500,000, to operate a telephone system in Buffalo.

FINDLAY, OHIO.—The Findlay Home Telephone Company has been granted a franchise for an exchange at Rawson. A number of farmers' lines will be built.

GAFFNEY, S. C.—The Gaffney Telephone Company has permanently organized and will construct a complete system of 150 instruments, for which it is now in the market.

GALION, OHIO.—The Galion Telephone Company, which commenced business a short time ago, is experiencing a steady growth. It now has 350 telephones installed.

ELLICOTT CITY, MD.—The Howard Telephone & Electric Lighting Company wants cross-arms, insulator pins and brackets, No. 9 and No. 14 wire, telephones and switchboards.

HARTFORD CITY, IND.—A bitter war has begun between the Indiana Telephone Company, of this city, Marion and Montpelier, and the Bell Company, accompanied by rate cutting.

COLDWATER, MICH.—There are 348 telephones in use in this city, the popular rate of $2 per month for business places and $1 per month for residence having trebled the list of subscribers.

HOOPER, NEB.—The Hooper Independent Telephone Company has been formed, and some 40 telephones have already been subscribed for. Several extensions will be made to rural districts.

HUNTINGTON, IND.—The United Telephone Company has closed a contract for the erection of a telephone toll line from this city to Wabash, 50 miles, and also for a line from Wabash to Rochester.

WAUSEON, OHIO.—The Northwestern Telephone Company, with headquarters in this city, has increased its capital stock from $20,000 to $40,000. P. J. Lenhart is president and F. J. Spencer secretary.

ST. LOUIS, MO.—The American District Telegraph Company of Missouri was incorporated March 5. The capital stock is $100,000. The incorporators are H. A. Bennett, T. P. Cook, G. J. Frankel and others.

MINERAL CITY, OHIO.—The Exchange Construction Company, of Cleveland, has just completed the new exchange of the Tuscarawas Home Telephone Company, of this city. It starts with 200 subscribers.

ALBANY, N. Y.—A bill compelling all telephone, electric light and telegraph companies to place their wires in underground subways in the cities of the first and second classes has been introduced in the Assembly.

MARTINSBURG, W. VA.—The Maryland Telephone Company is extending its line from Hagerstown to this place, where it will connect with the Winchester system. This will make three telephone lines in this place.

CHICAGO, ILL.—The Union Telegraph & Telephone Company ordinance has been recommended for passage by the committee. "It is regarded as a boodle scheme. There is no fear that the line will actually be built."

KNOXVILLE, TENN.—The Cumberland Telephone Company has entered into the fight for patronage and is offering residence telephones free for three months. The People's Company has not made any concessions.

UPPER SANDUSKY, OHIO.—C. D. Juvenall, the well-known telephone promoter of this city, has obtained franchises for local exchanges at Jewitt and Scio, Ohio. Independent companies are being organized in these places.

CARROLLTON, OHIO.—The Stark Telephone Company has obtained a franchise for a new independent exchange. The system built here some years ago was sold about two years ago to the Central Union Telephone Company.

LEXINGTON, KY.—The citizens of this place are excited over the apparent overplus of telephone companies. A third franchise is asked for, and rates to be charged are as low as $1.50 for residence and $2 for business telephones per month.

WOLFSVILLE, MD.—A telephone company has been organized, with Dr. Alvey J. Smith, president; Ashbury E. Hoover, secretary, and William E. Hankman, treasurer. The company will construct a telephone line from Myersville to Wolfville.

SALEM, OHIO.—The Columbiana County Telephone Company has closed a contract with the Pennsylvania Railway Company to place telephones in all passenger and freight stations and telegraph offices owned by the company within the county.

DELAWARE, OHIO.—The Citizen's Telephone Company has found it necessary to order an extension to its switchboard, giving an additional capacity of 100 drops. The company now has 540 subscribers. About 7000 ft. of cable will also be installed.

NEWCASTLE, IND.—The Henry County Telephone Company has been organized here with a capital stock of $10,000, which may be increased at the discretion of the directors to $20,000. Many farmers are subscribing to the stock of the new company.

MEMPHIS, TENN.—The new Memphis Telephone Company has closed a contract with Wm. Gest & Company, of Cincinnati, for the construction of a new telephone and conduit system for the city of Memphis. The contract involves an outlay of about $250,000.

TOLEDO, OHIO.—Two independent telephone franchise ordinances are now before the City Council. Dr. Watson, acting for the newly organized Toledo Telephone, Telegraph & Messenger Company, and Frank F. Graves, acting for the Toledo Home Telephone Company, are the petitioners.

FINDLAY, OHIO.—The Findlay Home Telephone Company has placed a large force of men at work in the equipment of its exchanges and system in this city. Several hundred subscribers have been secured, and when the plant is completed the company will have nearly 1000 subscribers.

CAIRO, ILL.—The Cairo Telephone Company has sold its telephone system to John S. Ainsthorpe, M. C. Wright and others. The change of ownership will take effect April 1. It is announced that the new management will continue the system as an independent line, and will place it in first-class condition.

WHEELING, W. VA.—The farmers of this county are holding meetings and agitating the installation of rural telephones. The Ohio County Farmers' Institute has prepared papers endorsing the idea of a rural telephone system, and has sent out broadcast invitations to corporations interested, inviting them to install offices.

RAVENNA, OHIO.—The business of the Ravenna Home Telephone Company has increased 100 per cent since it commenced operations two months ago, and extensions have been made necessary. In order to carry out contemplated improvements the company has doubled its capital stock, increasing from $100,000 to $200,000.

YOUNGSTOWN, OHIO.—Word comes from Seattle, Wash., that Youngstown capitalists have received a telephone franchise there and will proceed to establish an independent telephone exchange. The company will be known as the Seattle Telephone Exchange Company. It is said that contracts to the number of 16,000 have been secured.

FARBER, MO.—The citizens of Farber and vicinity have organized a company to construct a telephone line from Farber to Hutchinson, a distance of 11 miles. The company is known as the Farber Telephone Company and was organized with R. E. Sisk as president, W. J. Crow vice-president, C. A. Devault secretary and William Lake treasurer.

LA CROSSE, WIS.—La Crosse is to be placed in direct communication with Milwaukee and Minneapolis over the telephone systems of the independent companies. The Boyden Telephone Company, recently organized at Baraboo, will string a line from Milwaukee to La Crosse and thence to Minneapolis. The independent companies will pool issues.

AKRON, OHIO.—The Akron People's Telephone Company is preparing to cover the entire county with farmers' party lines, giving a $12 rate with a charge of 5 cents for connection with Akron subscribers. Branch exchanges will be established at Tallmadge, Twinsburg, Peninsula, Pomeroy, Macedonia, Liberty, Clinton, Loyal Oak, Sharon and East Liberty.

SANDUSKY, OHIO.—The Home Telephone Company (Bell) opened its new exchange in this city a few days ago. The change was effected in 30 seconds and the patrons of the system were not inconvenienced in the least. The new switchboard has 1500 lines connected, with room for double that number. New instruments will be furnished all subscribers as soon as possible.

DETROIT, MICH.—A deal has been closed whereby the independent telephone franchise secured some time ago by J. W. Martin has been secured by Messrs. Everett, Pack, Moore and others, of Cleveland. A new company will be formed of which Mr. Pack will be presedent. It has been announced that about $500,000 will be expended in equipping the new line and in making connection with the United States Telephone Company's long-distance service, which is controlled by the same parties.

DETROIT, MICH.—The management of the Detroit Telephone Company, which was absorbed by the Michigan Company some time ago, but whose exchange is still in operation with a few hundred subscribers, announces a reduction of rates to $32 for business and $20 for residence telephones, thus cutting under the rates which the new People's Telephone Company intends to charge. When the People's Company plant is finished next fall Detroit will have three telephone systems.

NORTHVILLE, MICH.—The Northville Independent Telephone Company has secured the right to string wires on the Detroit & Northwestern Electric Railway Company's poles to Farmington and Pontiac, and on the Detroit, Plymouth & Northville Company's poles to Plymouth, and from there the Plymouth independent company continues on to Wayne, where connection will be made with the independent line running to New Boston, Romulus, Willow, Waltz, Carleton, Flat Rock and Rockwood. The Northville exchange has over 100 subscribers, Plymouth 98, Farmington and Wayne about a dozen, and this,

with the Pontiac exchange, will give connections with about 1000 subscribers.

STORM IN MICHIGAN.—A dispatch from Detroit of March 10 says: "Over 10,000 telephones were rendered useless to-day by the rain, which fell and froze during the entire morning. The 30-mile-an-hour wind which accompanied the rain raised havoc with the wires, weighed down, as they were, by ice. Officials of the Michigan Telephone Company to-night estimated their loss in the State at $20,000. Street car service was greatly impaired during the morning by ice. The storm was general throughout the southern part of the State, wires suffering everywhere." All through the Middle and Central Southern States a wind storm is reported, with a loss of thousands of telegraph and telephone poles. Chicago suffered severely.

ELECTRIC LIGHT AND POWER.

CULPEPER, VA.—The city will erect an electric light plant.

CLAYTON, ALA.—The city will issue bonds for electric light and water works.

WARRENTON, VA.—A charter has been asked for an electric light plant here.

HAGERSTOWN, IND.—This city has taken steps to secure a new electric light plant.

MADISON, NEB.—The municipal electric light plant has just been completed and accepted.

HENRIETTA, TEX.—The Henrietta Gin & Light Company will erect an electric light plant.

MARION, ALA.—A franchise has been granted a company for an electric light and power plant.

THORPE, WIS.—It has been decided to construct a $6,000 municipal electric lighting plant at once.

ROANOKE, ALA.—The city will issue bonds for the erection of an electric plant and water works.

COUSHATTA, LA.—Frank Pierson is interested in the establishment of an electric light plant here.

HASTINGS, NEB.—John N. Burke has just completed the Hastings municipal electric light plant.

DICKSON, TENN.—The city is considering the issuance of bonds for water works and an electric light plant.

BELLS, TENN.—The Empire Planing Mill Company will probably install an electric light plant to light the town.

RAVENSWOOD, W. VA.—The city is making investigations relative to the establishment of an electric light plant.

CENTERVILLE, ALA.—Ex-Sheriff Vance has asked for a franchise to build an electric light plant and water works.

CANTON, OHIO.—The Canton Light, Heat & Power Company has increased its capital stock from $150,000 to $225,000.

NECK CITY, MO.—Frank O. Chesney contemplates developing water power and installing an electric transmission plant.

CHICAGO, ILL.—A bill is in the Illinois Legislature to prevent discrimination by gas and electric light companies in their rates .

THESSALON, ONT.—The Town Council has decided to install an electric light plant, to be owned and operated by the town.

WHEELING, W. VA.—A bill has been introduced in the Legislature authorizing the establishment of a municipal electric light plant.

TULLAHOMA, TENN.—The town has authority to issue bonds for the proposed water works, electric light plant and sewerage system.

SANDERSVILLE, GA.—Holt & Brother contemplate building an electric light plant and a cottonseed oil mill. A stock company is being organized.

HAGERSTOWN, IND.—Sylvester Schaffer, of Muncie, has made a proposition to Hagerstown citizens to establish an electric light plant here to cost $7,000.

DENTON, MD.—Henry W. Hughes, S. Frank Cole and associates have applied for a franchise for the establishment of a light, heat and power plant for the town.

CARTERSVILLE, GA.—The Etowah Milling Company has made a proposition to install an electric light plant in its new mill, with sufficient power to light the city.

MERIDIAN, MISS.—The Meridian Light & Railroad Company has been chartered, with capital stock of $235,000, by John Kamper, R. W. Stoutz and William Ambrecht.

LAKE PROVIDENCE, LA.—Edward J. O'Beirne, of Birmingham, Ala., has received the contract, at $18,000, for the construction of the electric light plant and water works at this place.

SOUTH MILWAUKEE, WIS.—The Bucyrus Company has contracted for enlarging its present electrical plant. A 100-kw direct-connected unit and complete switchboard will be added.

NASHVILLE, TENN.—The West Nashville Power & Light Company has been incorporated with a capital stock of $15,000. Mark S. Cockrill, L. H. Davis, John H. Bell and others are the incorporators.

BUCYRUS, OHIO.—The Bucyrus Gas & Electric Light Company has been incorporated with $150,000 capital stock by W. C. Lemert, James B. Gormely, John W. Gwynne, Isaac Baxter and F. P. Kaler.

ROCKWOOD,TENN.—George E. Sylvester, of Davenport, Mass., has secured the contract for the construction of water works and electric light plant at Rockwood, for which $20,000 of bonds were recently voted.

TWO RIVERS, WIS.—The electric lighting and water works plant being installed here will be under municipal control. At a special meeting the city has voted on a bond issue arrangement which will bring the city into control of the plant on its completion.

PINE BLUFF, ARK.—The Citizens' Light & Transit Company has been organized with a paid-up capital of $200,000. The stockholders are all local capitalists. The company has been granted a 15-year contract for city lighting to the amount of $6,000 a year.

READING, PA.—The People's Light & Power Company has applied for a charter in this place. Those interested are James K. Getz, Alfred Gunkel, Ellsworth Leinbach, Milford N. Ritter, Frederick M. Yeager, Frank Brobst, A. L. Roth, Daniel J. Driscoll and Albert Webber.

FAYETTEVILLE, N. C.—This city has purchased the plant, machinery, etc., of the Fayetteville Electric & Gas Company for $13,500. The affairs of the company have been in the hands of a receiver and an order of the Court will be necessary to a sale. After this bonds will be issued.

PINE BLUFF, ARK.—The two companies, each of which recently applied for a franchase for an electric car line and lighting plant, have consolidated and will be granted a franchise under the name of the Bluff City Lumber Company. M. A. Austin, Alphonse Brewster, William J. Galbraith, William H. Langford and others are among the stockholders.

RICHMOND, IND.—The efforts of several taxpayers to prevent the construction of the municipal electric light plant has proven a failure. In the suit to enjoin the construction on the ground that the contract price ($144,000) was too high, the judge sustained the demurrer holding that the indebtedness would not exceed the constitutional limit. The work of building the plant will now proceed.

WINNIPEG, MANITOBA.—On Feb. 17, 1900, Winnipeg inaugurated a municipal system of electric street lighting. According to a report presented by Commissioner Stuart, the cost to the city per light per night has been less than 19½ cents. The year preceding the cost was 45 cents per light per night. In addition to the enormous reduction in the cost, from 45 cents per light per night to 19½ cents, the light furnished has been very greatly improved.

NEWBERRY, MICH.—The municipality of Newberry, Mich., has just started a 1200-light Warren inductor alternator, direct connected to an Erie Ball engine at a speed of 300 r. p. m. The council has been very much pleased with the outfit, which also operates two street lighting circuits of 40 50-cp incandescent lamps each. There is not an oil cup on the outfit and it is almost entirely automatic. The apparatus was furnished by J. Holt Gates & Company, Monadnock Building, Chicago.

SAN FRANCISCO, CALIF.—It is reported that Eastern capitalists, represented by R. G. Hanford, have secured from President C. W. Quilty the Mt. Hamilton water rights of the Electric Light, Power & Heating Company. A large impounding dam will soon be commenced on Smith's Creek, in the Santa Ysabel Valley, about 15 miles from San José, Calif. There is a fall of 1400 ft. in 18 miles, and it is estimated that 5000 horse-power can be developed for electric power purposes. It is claimed that the entire output has been contracted for by a large electric lighting company in San Francisco.

MONTREAL, QUEBEC.—Messrs. Henry W. Garth, L. J. Tarte, J. O. A. Laforest, E. S. Manny and J. A. Thivierge, all of Montreal, Quebec, are seeking incorporation from the Dominion Parliament as the Laval Electric Power Company, with a capital of $100,000. The object of the new company is to supply electric power, light and heat. The power house is to be located on Riviere de Prairie, where 10,000 horse-power can be readily developed at small cost. The expectation of the promoters is that their company will furnish light for all the villages along the north shore in that neghborhood and ultimately they expect to reach and do business in Montreal.

THE ELECTRIC RAILWAY.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company will extend its road to Boonsboro.

ELWOOD, IND.—The Union Traction Company will erect a $15,000 freight and passenger station in this city.

CINCINNATI, OHIO.—The Cincinnati & Cleveland Railroad Company is asking for a franchise in this city.

BERKLEY, VA.—The town council of Berkley has granted a franchise to the Norfolk Railway & Light Company.

CINCINNATI, OHIO.—The cars of the new Toledo, Fostoria & Findlay Electric Railway Company will be equipped with telephones.

BUCYRUS, OHIO.—The Buckeye Traction Company has secured a franchise in Crawford County for its line from Bucyrus to Norwalk.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has been granted a franchise to build an electric railway in this place.

CINCINNATI, OHIO.—The Zanesville, Adamsville & Coshocton Electric Company is after a franchise for a road between Coshocton and Zanesville.

CRAWFORDSVILLE, IND.—A company of home capitalists has been given a franchise by the City Council to operate an electric street car line here.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company is contemplating building a second line to Berea by the way of the Wooster Pike.

PORT CLINTON, OHIO.—The Lakeside, Napoleon & Western Electric Railway has been organized here by Eastern capital. The road will be 50 miles in length.

CINCINNATI, OHIO.—The Millcreek Valley Street Railway is considering the purchase of the Hamilton & Lindewald Electric Transit Company's plant at Hamilton.

NORWALK, OHIO.—A local company will be incorporated within a few days to build an electric railway from Tiffin to Norwalk, passing through Republic, Franks and Monroeville.

WASHINGTON, IND.—Z. F. Grayham, of this place, announces that he will build an electric railway to Loogootee, 17 miles east of Washington. Cincinnati capitalists are interested.

CINCINNATI, OHIO.—The Cincinnati & Lebanon Traction Company has been incorporated. Bids will be received and contracts awarded immediately on the completion of the surveys.

CINCINNATI, OHIO.—The Millcreek Valley Street Railway has accepted the franchise granted by the Butler County Commissioners over the Hamilton, Springdale and Carthage Pike.

PAINESVILLE, OHIO.—The Lake County commissioners have granted a 30-year franchise to C. W. Goodrich, P. W. Tuttle and L. B. Stanley for an electric railway from Geneva to Painesville.

DEFIANCE, OHIO.—The Toledo, Napoleon & Defiance Electric Railway Company has agreed to the terms of the Defiance county commissioners and has secured a 25-year franchise through the county.

CLEVELAND, OHIO.—Senator Martin Dodge, promoter of the Cleveland & Warren Electric Railway Company, organized about a year ago, has revived his project and states that the road will surely be built

CLEVELAND, OHIO.—The Cleveland Electric Railway Company and the Cleveland City Railway Company have united in submitting plans to the Union Depot Company for the extension of their tracks to the railway station.

LEXINGTON, KY.—An Eastern capitalist has been in this city conferring with local people with reference to an electric railway from Harrodsburg to Junction City. He also proposes building an electric light and ice plant.

SANDUSKY, OHIO.—The village council at Milan has granted a new franchise to the Sandusky, Norwalk & Southern Electric Railway Company, which will enable it to shorten the route between Sandusky and Norwalk and avoid several grades.

COLUMBUS, OHIO.—The Columbus, Winchester & Lancaster Traction Company has secured franchises in Winchester and Groveport, completing the franchise through Franklin County. A franchise has been asked for in Fairfield County.

NIOBRARA, NEB.—About 35 miles of electric railway in Knox and Boyd Counties are contemplated. The power will be furnished by the Niobrara Irrigation & Power Company, of which Arnold C. Koenig, Grand Island, Neb., is chief engineer.

MONTREAL, QUEBEC.—The Grand Trunk Railway has under consideration a plan to run electric cars of its own over the Victoria Bridge, across the St. Lawrence, at Montreal. The cars will connect with other electric lines on both sides of the river.

RAVENNA, OHIO.—The Portage County Commissioners have granted a franchise to the Northern Ohio Traction Company for the extension of its line between Kent and Ravenna. The Portage Lakes Traction Company also has a similar franchise.

DAYTON, OHIO.—The stockholders of the Dayton & Northern Traction Company met last week and approved the resolution adopted by the directors to issue bonds to the amount of $450,000 at 5 per cent for the completion of the line from Dayton to Greenville.

ST. LOUIS, MO.—At the regular monthly meeting of the St. Louis Railway Club, on March 8, at the Southern Hotel, Prof. George D. Shepardson, of the University of Minnesota, read a paper on "Electric Train Lighting." The paper was illustrated with the stereopticon.

NEW YORK CITY.—At the annual meeting of the stockholders of the Rapid Transit Subway Construction Company the following directors were elected to serve for a term of three years: W. H. Baldwin, Jr., August Belmont, James Jourdan, W. G. Oakman, Cornelius Vanderbilt.

COLUMBUS, OHIO.—The Columbus & Southern Electric Railway Company is placing contracts for the construction of the road. E. P. Roberts & Company, Cleveland, will be the engineers. The Westinghouse Electric & Manufacturing Company has the contract for electrical equipment.

CLEVELAND, OHIO.—The Cleveland, Painesville & Eastern Railway Company is buying a private right of way for an extension of its road from Painesville to Ashtabula. The road will pass through Madison and Geneva, paralleling the Lake Shore Railway, and fast time will be made.

CLEVELAND, OHIO.—M. J. Mandelbaum & Company, of this city, promoters of the Aurora, Wheaton & Chicago Railway, have secured franchises in Batavia and Geneva, opening the way for an extension of the road from Elgin to Aurora. The extension will be known as the Elgin City, Carpenterville & Aurora Railway.

PORTSMOUTH, VA.—The Central Labor Union has declared a boycott on the Portsmouth Street Railway on account of the action of the company in the case of certain of its employees who have allied themselves with the local Street Railway Employees Union. The discharged men have since been placed on the list of substitutes.

CLEVELAND, OHIO.—The Cleveland & Southern Railway Company, which was organized about a month ago, has increased its capital stock from $10,000 to $1,000,000. Franchises have been secured as far as Medina and construction work will start from Berea as soon as possible. Options for the right of way to Wooster are being secured.

NEW HAVEN RAILROAD.—The New Haven Railroad is said to be trying to purchase the roads operated by the Old Colony Street Railroad Company, its revenues having been impaired by the trolley roads between Newport and Boston. The New Haven is also preparing to complete its electric car service from Newport to Providence and Boston.

EAU CLAIRE, WIS.—Boston and Chicago capitalists are said to be working on a plan to combine the Chippewa Valley Electric Railway, the Eau Claire Light & Power Company, the Eau Claire Gas Light Company, the Eau Claire Water Works and the Chippewa Falls Water Works & Lighting companies. It is expected that the deal will go through soon.

CHICAGO, ILL.—The syndicate organized by Blair & Company, of New York, to take over the interests of Charles T. Yerkes in the Chicago elevated roads, is understood to include Thomas F. Ryan of New York, Marshall Field and Norman B. Bean of Chicago, as well as the Widener-Elkins street railway interests. The purchase price is reported at about $5,000,000.

INDIANAPOLIS, IND.—The Indianapolis & Lebanon Traction Company, just incorporated, has franchises for two routes between the two cities and will decide between them soon and begin the work of construction. The promoters say the line will ultimately be extended to Frankfort and Lafayette. The promoters and incorporators are all Indianapolis and Lebanon men.

BARBERTON, OHIO.—A. E. Townsend, promoter of the Barberton, Doylestown & Massillon Electric Railway, who secured a franchise about a year ago, has asked for an extension of time in which to commence work. He claims that additional capital has been secured and that a contract for construction work has been placed with the Knickerbocker Construction Company, of New York.

SAN FRANCISCO, CALIF.—It is stated that the recent consolidation of the street car lines of Oakland was accomplished by the Pacific Improvement Company selling all of the lines of the Oakland Railroad Company to the Oakland Transit Company. The sum paid is placed at $1,500,000. E. H. Rollins & Company, of Boston, will undertake the work of bonding and financing the new street railroad system.

CINCINNATI, OHIO.—The Cincinnati, Milford & Hillsboro Railroad will use the roadbed of the old Cincinnati & Fayetteville Railroad. The company, which is incorporated for $10,000, is officered as follows: W. F. Roudebush of Batavia, president; W. D. Murphy of Milford, vice-president; M. McKeehan, treasurer, and H. L. Wiggins, secretary. Connection with the Cincinnati Traction Company will be made at Linwood.

CLEVELAND, OHIO.—The Cleveland & Eastern Electric Railway Company is making additions to its power house at Gates Mills in anticipation of proposed extension. Contracts have been placed with the Westinghouse Electric & Manufacturing Company for a 250-kw rotary converter, with switchboard and other equipment for the main power house, and for a 200-kw rotary converter to be installed in a new substation at the junction.

NEW YORK RAPID TRANSIT.—It was recently reported that the Pennsylvania and Long Island Railroad interests proposed to sumbit a plan to the city authorities by which these interests could obtain possession of the proposed extension of the Rapid Transit Subway from City Hall to the Long Island Railroad's Flatbush Avenue terminus in Brooklyn. This report has been denied, however, by President Orr, of the Rapid Transit Commission.

SCRANTON, PA.—There is danger of another street car strike in this city, all on account of a passenger eating garlic on one of the cars of the Scranton Street Railway Company. The conductor ordered the offender to desist; a fight ensued, the conductor of the car being the aggressive party. The conductor was discharged. The Street Railway Union has taken the matter up and the company has been formally notified that the conductor must be reinstated.

TOLEDO, OHIO.—The Toledo & Northwestern Electric Railway Company has organized as follows: Directors: J. L. Yost, J. Q. Adams, I. Hubert, F. H. Collins, Wm. P. Heston, H. C. Warren, Ellis Bartholomew of Lima, E. W. Frink of Cleveland, G. L. McKibben of Van Wert; president, F. H. Collins; secretary, W. P. Heston; treasurer, John Q. Adams; Ellis Bartholomew, general manager. The road will be built by the Northern Ohio Electric Construction Company.

JANESVILLE, WIS.—Articles of incorporation have been filed by the Janesville, Beloit & Delevan Lake Railway Company. H. H. Clough of Elyria, Ohio, is the capitalist most actively interested in this interurban electric line. Options have been secured on the right of way between this city and Beloit and between Beloit and Rockford. It is the purpose to build the line between this city and Rockford at once, to extend the line from Beloit to Delevan Lake next year, and to arrange the location of the terminus in this city so that ultimately an extension may be easily built to Madison. The nominal capital stock of the company is $100,000.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Railroad Company, in its contest with the United Gas Improvement Company of Philadelphia, controlling the Connecticut Railway & Lighting Company of this State, won an initial success before the railroad committee at Hartford, which voted to give a hearing at which the attorney for the New Haven company said he would attack the financial condition of the trolley syndicate. President Hall of the New Haven Company says that his corporation will fight the syndicate on broad as well as technical grounds, and one of the longest and hottest railroad controversies in the history of the State seems certain.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company, which has absorbed the properties of the Lorain & Cleveland, the Sandusky & Interurban and the Sandusky, Norwalk & Southern, will have a total capitalization of $4,000,000, of which $1,500,000 will be in 5 per cent preferred stock, and the balance, or $2,500,000, in common. Bonds to the value of $3,000,000 will be issued and the money thus obtained will provide for the double tracking of the Lorain & Cleveland Railroad, completing the Sandusky & Interurban, including the Norwalk division, and the rebuilding and extending of the Sandusky, Norwalk & Southern. The property purchased also includes the local Norwalk lines. It is reported in Cleveland that the next move toward the consolidation of all the local interurban roads into one company will be the consolidation of the new Lake Shore Electric Railway Company with the Cleveland, Painesville & Eastern and the Northern Ohio Traction Company.

THE AUTOMOBILE.

BOSTON, MASS.—The proposed automobile show, scheduled for last week, did not come off.

CHICAGO, ILL.—A show is to be given at the Coliseum March 23 to 30. At present there are about 30 intending exhibitors.

WATERVILLE, N. Y., is a good name for a prohibition town. Mr. L. D. Edwards, principal official of the village of Waterville, N. Y., has issued an order forbidding the use of the streets of that town to automobiles. The reason assigned is that they frighten horses and so prevent farmers from coming to the village to do their trading. This cuts off the business of the traders. It is said to be the first instance where the automobile has been prohibited from using the public streets.

ILLINOIS.—Out in Illinois the farmers are taking up the automobile, and it is expected that during the coming summer the horseless carriage will be a common sight on the country roads in some portions of that State. The automobile manufacturers are receiving large orders from rural purchasers. This is an unexpected development of the trade. It shows, for one thing, that some of the Western farmers are up to date in their recognition of a real improvement. Another thing shown is that Western farmers are prospering.

NEW INDUSTRIAL COMPANIES.

THE STEIN & LANGLOS ELECTRIC MANUFACTURING COMPANY of New York City has been incorporated; capital, $10,000. Directors: George Stein, W. V. Langlos and C. F. Kabisch, New York City.

THE PACIFIC ELECTRIC CORPORATION has been incorporated, with San Francisco as the place of business. Directors: B. Hienrich, H. J. Summerhayes, T. Charlton, T. K. Wittich and E. H. Stearns. Capital stock, $50,000.

LEGAL.

THREE-CENT CAR FARE LAW VOID.—At Cleveland, Ohio, on March 11, a decision by Judge Ricks of the United States District Court was handed down declaring unconstitutional the 3-cent street car fare ordinance passed by the City Council two years ago. The Judge maintained that the ordinance interfered with existing contracts. The suit to restrain the city from carrying into effect the terms of the ordinance was brought by the local street car companies. Director of Law Hogsett states that the suit will be carried to the higher courts as soon as possible.

RAILWAY PATENT SUITS.—On page 406 of last week's issue were digested the three railway decisions in Thomson-Houston Company vs. Bullock and Nassau, and Lorain Steel Motor Companies. In both cases Messrs. Betts, Betts & Sheffield & Betts represented the complainants (the General Electric Company actually), and Mr. Frederic Betts argued the cases first before Judge Thomas, then before Judge Wheeler, and in the Circuit Court of Appeals before Judges Wallace, Shipman and Lacombe. Messrs Harding & Harding, of Philadelphia, represented the defendants in all the cases, Mr. C. V. Edwards, of New York, representing the defendants in the case against the Bullock Electric Company. Mr. William H. Kenyon argued the magnetic blow-out cases first before Judge Thomas, then before Judge Wheeler, and in the Circuit Court of Appeals. Mr. George J. Harding and Mr. F. S. Busser argued the Knight interlock case first before Judge Wheeler and afterward before the Circuit Court of Appeals. These decisions dispose of all three of these patents, as there is no further appeal.

OBITUARY.

MR. GILBERT WILKES, head of the firm of consulting electrical and mechanical engineers, of Denver, died there on March 11 from lung trouble. The body will be taken to Detroit. Mr. Wilkes, who was, we believe, the grandson of Admiral Wilkes, served 11 years in the United States Navy as ensign and then resigned to enter the electrical field. For several years he was commander of the Detroit (Mich.) Naval Militia, and served throughout the war with Spain on the Yosemite. He was elected a member of the American Institute of Electrical Engineers in 1890. Mrs. Wilkes is the daughter of Charles Denby, ex-Minister to China.

MR. ERIC E. ERICKSON, president of the Erickson Electric Equipment Company, Boston, died at his home in Boston Feb. 14 at the age of 50 years after a short illness. He was well known among the older members of the electrical fraternity, having been connected with various interests since 1885. In the early days of the Edison isolated lighting system he was connected with the Boston department at 50 Oliver Street. In later years he was identified with the production of the Aetna railway insulation, well known in every large electric railway equipment. Three years ago he organized the firm of the Erickson Electric Equipment Company, for the purpose of installing complete lighting and power plants, and the success of this enterprise has been proven throughout New England.

CAPT. GEORGE N. STONE, president of the Cincinnati Bell Telephone Company, died on March 8 of general collapse resulting from an abscess in the abdomen, for which he had been operated upon. He was 60 years old. He was a large stockholder in the telephone company, also in the street railway and gas companies. His management of the telephone company was so successful that no rival company had ever been able to get a foothold in Cincinnati. He was born in Stark, N. H. He was a lieutenant and captain in the 7th Rhode Island Regiment during the Civil War and finally served on Gen. Schofield's staff. As a lover of horses he made the discovery of Maud S., the celebrated trotting mare—named after one of his daughters. The daughter referred to is the wife of Mr. A. A. Cary, the well-known mechanical engineer and expert, of New York City.

SENATOR C. L. MAGEE, of Pittsburg, editor, statesman, philanthropist and financier, died last week at Harrisburg, Pa., after an illness of more than two years. His death was unexpected, as it was generally believed by his friends that he was improving in health. Mr. Magee was born in Pittsburg in 1848. Through the death of his father, when the boy was 15 years of age, he was obliged to go to work to help support his mother and three younger children. After a period as office boy he obtained a clerkship, and in 1869 was made cashier in the City Treasury and in 1871 was elected City Treasurer and was re-elected in 1874. He was elected State Senator in 1892, and was twice re-elected. He was a director in numerous Pittsburg banks, trust companies and insurance companies, and at the time of his death was the principal owner of the Pittsburg *Times*. He was widely known in electrical circles through his connection with trolley railway enterprises.

F. O. MATTHIESSEN.—Private dispatches announce the death in Paris of Francis O. Matthiessen, who for several years was a director of the American Sugar Refining Company. Mr. Matthiessen retired from active business about a year ago and has since spent his time in travel for the benefit of his health, which for some time before had been failing. He was a native of the duchy of Holstein, where he was born on Dec. 23, 1833. He was educated in the city of Altona and subsequently was employed in a sugar refining factory in Hamburg. After learning the sugar refining business Mr. Matthiessen came to the United States in 1859. For the next four years he was employed in this city and Boston, and in 1863 he went into business for himself. Forming a partnership with W. A. Weichers, he opened a refinery in Jersey City, the firm being known as Matthiessen & Weichers. Subsequently the establishment was transferred to a company, Mr. Matthiessen being retained at the head of its management. In 1887, when the American Sugar Refining Company was formed, Mr. Matthiessen's company was merged into it and he became a director and chairman of the manufacturing committee. The disagreement with H. O. Havemeyer which was the cause of the retirement of John E. Searles as treasurer and as a director of the American Sugar Refining Company, was followed by the retirement of Mr. Matthiessen in the latter part of 1899. He and Mr. Havemeyer differed upon questions of policy concerning the administration of the company's affairs, and also as to the management of the Matthiessen refinery. When he resigned, Mr. Matthiessen disposed of the greater part of his holding of sugar shares. Mr. Matthiessen married in 1865 Miss Emma Boyles, of Philadelphia. They had two children, a son who died in childhood, and a daughter who died when she was about 20 years old. Mr. Matthiessen was a director of the Goubert Manufacturing Company and the New Jersey Street Railway Company, and was president of the Weston Electrical Instrument Company, of Newark, N. J.

PERSONAL.

MR. MARCONI is due here this week on the White Star liner "Majestic."

MR. C. T. YERKES has sailed for England to look after his London underground railway deals.

MR. A. MILLER BELFIELD, hitherto associated with the patent law firm of Charles A. Brown & Cragg, of Chicago, has been admitted to partnership.

MR. EUGENE GRIFFIN and Mr. W. J. Clark, of the General Electric Company, have both left for Europe, the former, it is said, for rest and recreation.

MR. J. P. MORGAN is booked to sail for Europe on the "Oceanic" on March 27 to be absent longer than usual. It is understood that he will take a complete rest.

MR. F. SARGENT, the electrical engineer of Chicago, has been in New York on professional matters and purchasing apparatus for a new plant which he is constructing.

DR. LOUIS DUNCAN and Dr. Cary T. Hutchinson have been appointed electrical experts to assist Mr. W. B. Parsons, chief engineer of the Rapid Transit Commission of New York City.

MR. THOMAS E. MITTEN, general superintendent of the Milwaukee Electric Railway & Light Company, has resigned to accept a position in the operating department of the International Traction Company, Buffalo.

MR. T. HERBERT MINSHALL, borough electrical engineer of the town of Croydon, Eng., is due to arrive in this country during the present week. He will look into the matter of American engine building while here.

DR. PARK BENJAMIN is doing the work of his life in behalf of the plan to place a fine Dewey triumphal arch at the Battery, a plan to which large sums of money are already pledged. He is the life and soul of the movement.

MR. FRANK CHAPMAN, formerly purchasing agent of the Stuart-Howland Company, Boston, has severed his connections with that concern and will now be associated with the Belcher & Loomis Hardware Company, of Providence, R. I.

MR. JOSEPH P. ORD, who recently resigned as vice-president of the General Electric Company, has joined the firm of J. P. Morgan & Company. Mr. Ord went into the General Electric Company at the instance of Mr. Morgan, whose confidence he has long enjoyed.

MR. WILL F. HAYES, who, it will be remembered, suffered an attack of illness which caused his retirement from business for several months, is again in Cincinnati and apparently completely restored to health. His friends hope to see him soon installed in business.

MR. PHILIP W. MOEN, third vice-president of the American Steel & Wire Company, will not oppose the consolidation of the company as a part of the United States Steel Corporation. He says that the Worcester interests, formerly identified with the Washburn & Moen Manufacturing Company, will not stand in the way of the consolidation.

MR. H. C. HUTCHINSON, for several years general superintendent of the Cincinnati Edison Electric Company, has been promoted to be assistant general manager. W. E. Hopton, of Jersey City, N. J., becomes general superintendent. Mr. Hopton went to Cincinnati from Chicago, where he was identified with the work of the North American Company.

MR. W. H. PELTON, a well-known Cleveland electrical engineer, and head of the Pelton Engineering Company of that city, has been confined to his bed for a month past as the result of a severe shock received while inspecting an arc lighting plant which the company recently installed at Lakewood, Ohio. He is still in a very weak condition, so that it will probably be some time before he can take up active work.

MR. JOHN E. SEARLES, who has been well known in electrical circles from his occasional ventures in the electrical field, has gone into bankruptcy. It is said that his assets exceed liabilities and that he will have some portion of his fortune left. The number of his enterprises was legion, and while by no means always judicious in his investments, he deserves credit for his readiness to see the merits of a new thing and his willingness to help it along. There was hardly a branch of industry with which he did not have financial associations.

PROF. S. W. STRATTON, of the University of Chicago, who has been appointed director of the new Treasury Department, Division of Standard Weights and Measures, is professor of physics at the University of Chicago. He was asked about a year ago to reorganize the office of weights and measures to meet

the demand for scientific work. Prof. Stratton was born in Litchfield, Ill., in 1862, and was graduated in 1884 from the University of Illinois, where he was professor of physics and electrical engineering until 1892, when he went to the University of Chicago as a member of the department of physics.

SIR HENRY McCALLUM, the new governor of Natal, South Africa, is an old telegraph engineer and has been stationed in Newfoundland. He was with Kitchener at the War College, graduating in 1871, when he became superintendent of military telegraphs for the southern district of England. He is able to build a bridge, a highway or a conduit, to construct a railroad, to set up, run and repair a locomotive; to operate electric wires and control a telegraph system, to survey a territory, to build forts and plan defenses, to organize and preside over a municipality, and to administer a territory as large as the British Isles. His record, in college or in the colonies, is a unique one, and few of the British colonial staff can show a round of such conspicuous and unbroken success in so many diverse capacities.

EDUCATIONAL.

THE UNIVERSITY OF PENNSYLVANIA has issued circulars of information regarding its electrical engineering and mechanical engineering courses.

THE SIBLEY JOURNAL.—The February number of the Sibley *Journal of Mechanical Engineering*, which is published by the students of Sibley College, Cornell University, Ithaca, N. Y., contains an article by Prof. Harris J. Ryan on the three-phase alternators of the Metropolitan Street Railway Company of New York. The article is illustrated.

THE ELECTRICAL ENGINEERING LABORATORY of the University of Nebraska is now well equipped for the illustration of commercial conditions in the transmission of power by alternating currents, and for original work in that line. New apparatus, as follows, has recently been added: A 15-kw General Electric two-phase, three-phase stationary armature generator of 60 frequency; a two-phase 220-volt Westinghouse converter and an induction motor, each of 10 kilowatts; a pair of Packard transformers, each of 10-kw capacity, specially wound for experimental work, with both primaries and secondaries divided into four separate coils, readily adaptable to the production of every commercial voltage from 50 to 2000, and with full current capacity at practically every step, also permitting (through regulation of the generator) the production of any desired voltage within the above range. An imported electric furnace has also just been set up, making the equipment for experimental work very extensive.

Trade Notes.

THE ATLAS CEMENT COMPANY, Northampton, Pa., is now using eight Cross oil filters, purchased from the Burt Manufacturing Company, Akron, Ohio.

THE LINCOLN ELECTRIC COMPANY, of Cleveland, is furnishing 12 of its recharging motors and controllers to a newly organized concern in Chicago for the manufacture of electric vehicles.

THE STURTEVANT ENGINEERING COMPANY, LTD., of London, Eng., notifies us that to accommodate its growing business it has taken the building at 147 Queen Victoria Street, E. C. Mr. George A. Mower is managing director.

THE TUDOR BOILER COMPANY, of Cincinnati, Ohio, has commenced the construction of the Babcock & Wilcox type of boilers. This company has just sold three 300-hp water tube boilers to the Chicago Iron Works at East Chicago, Ind.

THE GEO. C. TOWLE MANUFACTURING COMPANY, of Lancaster, Pa., has opened an office and salesroom at 74 Cortlandt Street, New York, where it is showing a full line of the newest types in fan motors; also small power motors in various sizes.

NEW ELECTRICAL CONCERN.—L. W. Thies and Dr. Carl Markt have organized a company in Hamilton, Ohio, to manufacture several electrical inventions brought out by the former gentleman. They will also do a jobbing business in electrical supplies.

THE BICKFORD DRILL & TOOL COMPANY, Cincinnati, Ohio, reports a good volume of business, the principal demand being for multiple drills of the heavier types. Three multiple drills have just been shipped to the Baltimore & Ohio shops at Baltimore.

CIRCULAR LOOM.—The Western office of the American Circular Loom Company, now located at 141 South Clinton Street, Chicago, will move to 130 West Jackson Boulevard, the Electrical Building, corner of Desplaines Street. Mr. Thos. G. Grier is Western manager.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, reports an unusually large demand for power generating machinery, some of it going abroad. A recent order is for a 600-kw engine type direct-current generator for the Belfast shipyards, Belfast, Ireland.

THE AMERICAN BRIDGE COMPANY will furnish the steel work, amounting to 3000 tons, for the new Astor Building, at the corner of Fifty-fifth Street and Fifth Avenue, New York City, and also about 2000 tons of the same class of work for the new Custom House in New York City.

THE RICHMONDT WIRE CONDUIT COMPANY, Milwaukee, Wis., has arranged to occupy the Wisconsin Central's old shops at Waukesha and will at once equip the plant. The company will make its own steel pipe and finish the product complete, ready for market. It reports a tremendous business and its conduit receiving universal support.

THE ADAMS-BAGNALL COMPANY, of Cleveland, is equipping the plant of the Link-Belt Manufacturing Company, of Chicago, with an arc lighting system of 120 lamps. It is making several shipments of various kinds of lamps to Japan and Southern China. The company states that its business for February was 25 per cent greater than the corresponding month last year.

DEMAND FOR CARBONS.—The United States Carbon Company, of Cleveland, Ohio, reports that its business at present is extraordinary for this time of year. Usually the demand for arc light carbons begins to fall off about Feb. 1, in anticipation of the longer spring days, but thus far this year there has been no decrease in the demand, which bids fair to hold up steady into the spring months.

THE VAN DORN-ELLIOTT ELECTRIC COMPANY, of Cleveland, which has succeeded to the business of the electrical department of the Van Dorn & Dutton Company, of that city, has elected officers as follows: J. H. Van Dorn, president; F. Schneider, vice-president; W. A. Dutton, secretary and treasurer, and W. H. Elliott, manager. The company is at work on a large amount of repair work.

MR. JOHN L. MILTON, of the Sterling Electric Motor Company, Dayton, Ohio, reports a steady growth in the company's motor business, which proved a success from the start, and announces that it has booked several good contracts for the coming season. This company has given its entire time and attention to the plan of building only small motors, with special tools and processes which enables it to furnish these at the very closest price.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports orders running principally to small machinery. One is for a 300-kw slow-speed belted machine for the Bradley Estate, Cleveland, Ohio. Other orders are for a 100-kw slow-speed belted generator and motors for the Easton Silk Mills, Easton, Pa., and a 200-kw direct-current generator for the Globe-Wernicke Company, Norwood (Cincinnati) Ohio. The latter is a duplicate of a generator ordered about a year ago.

THE GILLILAND ELECTRIC COMPANY, Adrian, Mich., informs us that its factory is running full time and that it is loaded up with work. Among other orders it has received a large one from the A. B. Dick Company, manufacturer of the Edison mimeograph, for cabinet work for that class of apparatus. It expects to be prepared to take care of any kind of special wood or metal work and to manufacture at a low cost a complete line of electrical specialties, telephone parts, etc.

NEVER HAD AN EQUAL.—Competent judges say that the Pan-American Exposition will be superior to anything of its size ever seen on this continent, and it is within 12 hours' ride of over 40,000,000 people. How can it fail to be a success when you consider that it is reached from all directions by the New York Central Lines, which comprise the New York Central, Boston & Albany, Michigan Central, Lake Shore, Big Four, Pittsburg & Lake Erie and Lake Erie & Western railways?

THE WESTERN ELECTRIC COMPANY, Chicago, is receiving many favorable reports from the different plants using its series enclosed alternating arc lighting system. The economy of operation and ease of management, together with the many special features of excellence, are said to be winning the enthusiastic approval of station managers. Long life, reliability in action and freedom from accidental injury are some of the points which the system affords under all conditions met in practice. Many plants are being installed.

THE MILWAUKEE ELECTRIC COMPANY, Milwaukee, Wis., has been awarded the contract for the electrical equipment of the C. Reiss Coal Company's coal docks at Sheboygan, Wis. It is said that these docks will be the most thoroughly electrically equipped in the Northwest. Messrs. Keelyn & Smith, of Milwaukee, have the contract for the necessary switchboard and construction work. The machinery contract calls for one 200-kw 250-volt generator, direct connected to a Ball 200 r. p. m. engine; one 40-kw 250-volt belted generator, and motors aggregating 335 horse-power.

THE STANDARD MACHINERY & EQUIPMENT COMPANY, of Cleveland, Ohio, dealers in second-hand power and electrical equipment, has recently bought up the plants of the Lorain Lighting Company, Lorain, Ohio, and the Ceramic City Light & Power Company, East Liverpool, Ohio. It has recently sold three large engines to the Hawley Electric Light Company, of Scranton, Pa., a 375-kw General Electric generator to McDowell & Foster, Pittsburg, Pa., and two arc machines to Blonkins Brothers, Milwaukee. The company reports the demand for second-hand electrical equipment largely in excess of the supply.

THE ST. LOUIS AUTOMOBILE & SUPPLY COMPANY, Twenty-third and St. Charles Streets, St. Louis Mo., desires to announce that it now has the following representatives in New York, Chicago and Hartford: Messrs. Chas. E. Miller, 97 Reade Street, New York; Ralph Temple, 291 Wabash Avenue, Chicago, Ill., and Messrs Post & Lester, Hartford, Conn. The St. Louis Automobile & Supply Company manufactures Dyke's automotorette, Dyke's float feed carburetter, Dyke's tool set, Dyke's new flexible running gear, gasoline engines from 1 to 10 horse-power, transportation devices, etc., and carries a full line of automobile supplies.

SEAMLESS BRASS TUBE.—We learn that the U. T. Hungerford Brass & Copper Company, New York, has lately secured some large contracts for supplying the United States Government with seamless brass tubes. The United States Government subjects all tubes it purchases to very critical tests, and the fact that the U. T. Hungerford Brass & Copper Company is able to furnish material satisfactory in every way to the Government inspectors is a high endorsement of its product. We also learn that the same company is furnishing considerable quantities of seamless brass and copper tubes to contractors now engaged in the construction of war vessels for the Government.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "chloride accumulator," has found it necessary to open a sales office at San Francisco, Calif., to take care of the increasing volume of business in the Pacific Coast States and extreme western territories. The office, which is located at Nevada Block, has been placed in the charge of Mr. R. B. Daggett, who has for a long time been connected with the staff of engineers at the Philadelphia office, and his experience gained there will enable him to handle the various problems of modern storage battery practice arising in the new district with skill and promptness.

A "STARTLING" CIRCULAR is issued by the Onondaga Dynamo Company, Syracuse, N. Y. As the innocent recipient unfolds it, it proves itself "living literature" by flopping about in a weird manner and emitting a loud buzz. An investigation shows it to be but a clever application of the "buzzer" toy of boyhood days—a disk of cardboard, a rubber band and a piece of wire—carefully "set" when the circular is folded and placed in the envelope, and ready to fix the attention of the man who opens it. It is attention fixed in a good cause, how-

ever, as the circular illustrates and describes several types of the Onondaga dynamos and motors in an interesting manner.

OLDS FACTORY ON FIRE.—A dispatch from Detroit, Mich, of March 9 says: "The Olds Motor Works, manufacturers of gas engines, automobiles and other vehicles, located at 1308 to 1318 Jefferson Avenue, was completely destroyed by fire this afternoon, entailing a loss of over $100,000. The building, which was a three-story brick structure covering half a square, was erected about a year ago. The plant was shut down at 12 o'clock, noon, for half a day, and the fire broke out soon afterward. Two tanks of gasoline were located in the building, and it is supposed that these exploded and caused the fire. In less than an hour the structure was practically destroyed. The entire season's output of the Olds Works, which was stored in the large building, was destroyed. The plant was insured for $65,000."

A SUMMERY SUGGESTION.—A cheap and satisfactory way of spending a pleasant summer is pointed out in a booklet issued by the Emerson Electric Manufacturing Company, of St. Louis, Mo. The old notion that it is necessary to fly from home and business to cooler latitudes in order to find comfort during the heated term is exploded by the Emerson Company. It points out that equal comfort can be obtained at home and at business by using Emerson fans. The booklet gives illustrations of the different styles of the fans manufactured by the company, so that it is an easy matter to select one to suit the conditions of each case. These fans are made in desk and ceiling types, and it is evident that it will cost less to be cooled by a fan that to migrate to strange places and submit to the incidental annoyances and deficiencies which are inseparable from excursions of this character.

THE SAFETY ELECTRICAL MANUFACTURING COMPANY, of New Orleans, when called upon recently by a representative of the ELECTRICAL WORLD AND ENGINEER, was found to be in a most prosperous condition and is doubling its floor space for the manufacturing and supply business. Besides being agent for a number of manufacturers, and carrying supplies, a large switchboard manufacturing business is carried on. The company has four experienced engineers as its principals, and is prepared for taking complete contracts for electric light and power plants in its territory. The electrical equipment of sawmills will be given special attention. There is certainly room for a strong contracting and supply house of this kind in the New Orleans territory, and this concern, judging from its rapid growth since last August, is filling the place well. One commendable feature of this company's work is that of employing only engineers competent to size up a situation and make estimates as traveling salesmen.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, of Cleveland, Ohio, is now located in new quarters at 24 Viaduct Building, that city. Of late this company has devoted considerable attention to the manufacture of telephones and parts, and not long ago found its factory entirely inadequate to its needs. At present the company is occupying the entire floor of a large building at the address mentioned, and expects to make still further additions which will give it a floor space of 16,000 square feet. The new quarters are in the best part of the business and manufacturing portion of the city, convenient for customers, and having excellent shipping facilities. The Century Company has recently bought out the plant and business of A. M. Taylor & Company, Ravenna, Ohio, manufacturers of the Taylor terminal head and lightning arrester. The Ravenna factory will be abandoned and the two specialties will be manufactured at Cleveland. Mr. A. M. Taylor will be identified with the Century Company, representing it in the East.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, New York and San Francisco, announces that it has more than doubled its working capacity, and has installed new and complete machinery for the purpose of turning out its well-known specialties. It expects to place on the market in the near future various improvements upon its standard line of fuses, fuse boxes, lightning arresters and connectors. The American Company also manufactures a complete and fine line of both silk and magnet wire and carries a stock of all sizes constantly on hand. Its Eastern office is at 116 Nassau Street, New York, in charge of Mr. W. B. McCurdy. The office is completely stocked with a full line of fuses, fuse wire, lightning arresters, connectors, etc. The Western office, at San Francisco, Calif., will be conducted on the same line as the Eastern office. The company calls attention especially to the completeness of its stock, the high quality of its goods and the reasonableness of all its prices. With enlarged facilities and increased capacity, the American Electric Fuse Company expects to give even better service than it is doing at present. Catalogues, samples, or any desired information will be furnished.

VENTILATION AND HEATING COMBINED.—Experience has clearly demonstrated that in this climate no system of ventilation can be successfully operated by itself and independently of the method of heating that may be adopted. It is, in fact, a vital element of success that the two systems be most intimately combined, for they are clearly independent, and when properly applied are so interwoven in their operation and results that disunion is certain to bring about failure. For the purpose of ventilation the fan was first applied upon a practical scale about the middle of this century, but only to a limited extent, and it was not until the fan and the steam heater in marketable form were introduced by B. F. Sturtevant, of Boston, Mass., that the so-called "blower system" became a reality. The system, of which these two elements are the most important factors, as originally made by this house, has naturally been known as "The Sturtevant System." This system is at once practical, successful and economical; for, air being the natural conveyer of heat, it may, when properly warmed and supplied, perform the double office of heating and ventilating. As applied, the Sturtevant system forces the air into the apartment by the pressure or plenum method.

TECHNICAL EDUCATION BY MAIL.—Ambitious men who desire to obtain better positions and higher wages should investigate the very interesting free scholarship offer made by the American School of Correspondence, Boston, Mass. This well-known school has among its instructors men who are regular teachers in several of the great technical schools of Boston, and has unusual advantages for teaching the theory of trades and engineering professions. Its free scholarship offer for engineering and mechanical drawing is a feature which should attract attention. Without leaving home or losing time from his regular work, the student pursues a thorough course of study under the direction of able instructors. Papers guiding him in his work are prepared and delivered to him. These papers, free from the technicality which usually encumbers text-books, are clear and concise in language and much superior to the ordinary text-books on the subjects on which they treat. Besides this, special information concerning any difficulties which may arise in their course is furnished to the students. Altogether the course of study outlined is exceedingly attractive, and long experience has shown that no other method so fully meets the requirements for men who have but little time for study as that of teaching by mail.

THE PELTON WATER WHEEL COMPANY, San Francisco, recently furnished equipment for plants as follows: Keswick Electric Power Company, California, head, 1200 ft., three units of 1600 horse-power each, for electric transmission; British Columbia Electric Railway Company, Victoria, B. C. (second station), head 700 ft., one unit of 900 horse-power for electric transmission and lighting; Big Creek Power Company, California, head 920 ft., 900 horse-power, driving two generators for power and light (second station); 100-hp plant for Pigeon Bay, New Zealand, operating an electric light generator; 75-hp installation for a tea estate in Java, electric light plant; 2000-hp unit under 500-ft. head for electric transmission plant in Colorado; 150-hp wheel, 250-ft. head, operating flour mill and electric light plant in Utah; 75-hp wheel, 400-ft. head, operating electric light plant in Borneo; 50-hp wheel, running generator for mine in Idaho; double unit of 250-hp capacity, electric transmission plant near Auburn, Calif.; 30-hp wheel, electric lighting plant, Apia, Samoa; 30-hp wheel and transmission machinery for electric light plant, Guatemala; 30-hp wheel for electric lighting, Sydney, N. S. W., and a 6-ft. wheel, 200 horse-power, for a silk mill in Japan.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 5, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

669,072. TELEPHONE APPARATUS; P. C. Burns, Chicago, Ill. App. filed July 31, 1899. This invention provides for automatically operating the signal bell or other signal indicating device by means of one of the necessary parts of the telephone set.

669,085. BATTERY ELECTRODE; G. Heidel, St. Louis, Mo. App. filed March 21, 1900. Insulating plugs are inserted in the edges of the plate to separate it from the walls of the cell.

669,094. TELEPHONE APPARATUS; W. O. Meissner, Chicago, Ill. App. filed May 2, 1898. Details.

669,100. PHYSICIANS' ELECTRIC LAMP; P. M. Randall, New York, N. Y. App. filed May 16, 1900. A small lamp, mounted at the end of a pencil-like handle, to which a circuit closer is attached.

669,101. INCANDESCIBLE BODY; Henry Reeser, Paris, France. App. filed July 3, 1899. (See Current News and Notes.)

669,102. COMBINED SWITCH AND RHEOSTAT; H. E. Reeve, Brooklyn, N. Y. App. filed July 2, 1900. Details of construction.

669,114. SUPPORT FOR TELEPHONE RECEIVERS; J. J. Hartl, Chicago, Ill. App. filed Oct. 26, 1900. A bracket strapped to the transmitter arm for holding the receiver.

669,130. MANUFACTURE OF ELECTRICAL HEATING APPLIANCES; Adolph Vogt, Westminster, Eng. App. filed May 23, 1900. (See Current News and Notes.)

669,149. CAPILLARY ELECTROMETER FOR RELAY PURPOSES; Albert C. Crehore, Tarrytown, N. Y., and Geo. O. Squier, Washington, D. C. App. filed Oct. 20, 1899. (See Current News and Notes.)

669,151. ELECTRIC LAMP SOCKET; J. H. Trumbull and H. Trumbull, Plainville, Conn. App. filed Dec. 16, 1899. The socket contains a push switch operated by two buttons, one being white and the other black. The position of the buttons and the condition of the main circuit will show whether the filament is complete or not.

669,155. LIGHTNING ARRESTER; Herbert C. Wirt, Schenectady, N. Y. App. filed April 30, 1897. (See Current News and Notes.)

669,198. ADVERTISING DEVICE; W. E. Fowler, J. Owen and S. H. Metcalf, Seattle, Wash. App. filed April 17, 1900. A wheel carrying a series of signs is rotated step by step by a solenoid.

669,271. ART OR PROCESS FOR MAKING PHOSPHORIC ACID; Frank P. Danbergh, Buffalo, N. Y. App. filed April 20, 1896. (See Current News and Notes.)

669,218. ELECTRIC RAILWAY; H. Hirst, London, Eng. App. filed Jan. 29, 1901. The branch conductor leading to a section of the working conductor contains an electromagnet which prevents a particular section ahead from becoming energized to prevent the movement of any car that may be on the section ahead and thereby avoid collision.

669,240. ELECTRODE PLATE FOR ELECTRIC AUTOMOBILES; H. F. Hobel, Berlin, Germany. App. filed Oct. 20, 1900. The plate comprises a frame having a series of bars from which two series of leaves project; one series extending from the central portion of the bars to the front and the other series to the rear.

669,291. CURRENT INTERRUPTER; Elihu Thomson, Swampscott, Mass. App. filed Dec. 26, 1899. (See Current News and Notes.)

669,299. DYNAMO ELECTRIC MACHINE; N. C. Bassett, Lynn, Mass. App. filed Dec. 12, 1899. A motor provided with two sets of commutator brushes in combination with a controller provided with contacts for regulating the speed of said motor, and contacts for closing the motor circuit through either of said sets of brushes.

669,306. INCANDESCENT LAMP; John W. Howell, Newark, N. J. App. filed Nov. 28, 1898. On details of telephone switchboard lamps.

669,310. ELECTRIC METERING SYSTEM; Eustace Oxley, Lynn, Mass. App. filed Oct. 12, 1899. A meter for arc light circuits capable of recording at a plurality of rates. The meter has one of its circuits in series with the translating constant current devices, and the other in shunt relation; means controlled by the same circuit which supplies the translating devices vary the potential at the terminals of the shunt coil to change the recording rate of the meter.

669,336. METHOD OF LOCAL APPLICATION OF ELECTRIC TREATMENT TO THE HUMAN BODY; H. Behrendt, Worms, Germany. App. filed Sept. 18, 1900. Electrotherapeutical treatment which consists in subjecting a part of the human body to action of static electricity while the blood is drawn to the surface of such part by producing a vacuum thereon.

669,338. ELECTRIC CLOCK; S. Fisher, New York, N. Y. App. filed June 8, 1900. Details of a clock whereby a magnet stores power in the spring at short intervals.

669,358. INSULATED ELECTRIC CONDUCTOR AND METHOD OF MAKING SAME; Chas. P. Steinmetz, Schenectady, N. Y. App. filed July 30, 1900. (See Current News and Notes.)

669,362. REGULATING DEVICE FOR ELECTRIC CURRENTS; W. Emmott, Halifax, Eng. App. filed Dec. 28, 1897. The invention consists of the combination with any ordinary switch of an impedance coil or a coil with a movable core or a coil divided into separate circuits, so arranged that the current can readily be switched onto the lamps direct or so as to be more or less impeded.

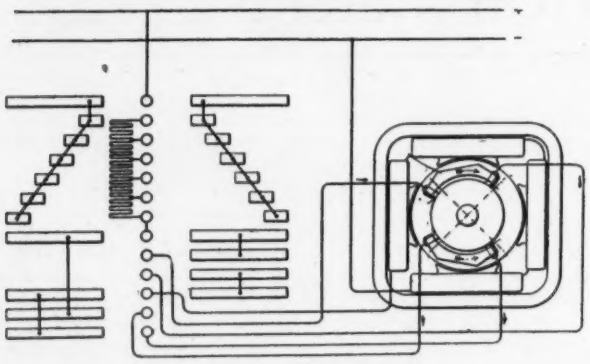
669,366. TELEPHONE SYSTEM; C. Malthaner, Minneapolis, Minn. App. filed March 16, 1900. According to this invention the attention of the called operator is attracted by the ringing of a bell and at the same time by the lighting of a supervisory lamp indicating which trunk to answer, and doing away with the extra lamp and buzzer at present employed in a local circuit, the supervisory signal at the calling operator's exchange being controlled over the same wires that are used for talking, no third wire or ground being employed.

669,438. MAGNETIC BLOW-OUT BRUSH HOLDER; A. C. Eastwood, Cleveland, Ohio. App. filed Dec. 3, 1900. The pole pieces of the magnet form two sides of an inclosure containing the brush; this affords a uniform direction of the lines of force through the arc, which more quickly ruptures it.

669,439-40. ELECTROLYTIC PROCESS FOR RECOVERING METALS; Hans A. Frasch, Hamilton, Canada. App. filed July 30, 1900. Relates to the production of an electrolyte of great purity, by providing for the direct extraction of such metals whose hydro-oxides are soluble in a solution of alkali or ammonia. By the direct action of an electric current upon a solution of a salt of ammonium in the presence of an anode bearing the metal to be extracted, such as copper or nickel, the corresponding ammonium salt of the metal is obtained at the anode, while the metal itself is deposited on the cathode and the ammonium salt originally employed is recovered. The second patent relates to apparatus for carrying out the above method.

669,441. METHOD OF PRODUCING ALKALI BY ELECTROLYSIS; Hans A. Frasch, Hamilton, Canada. App. filed Aug. 16, 1900. Halogens or mineral salts are separated from corresponding alkali salts by binding the acids or chlorine in nascent state to metals which form a part or the whole of an anode in an electrolytic bath.

669,442. PROCESS OF RECOVERING AND SEPARATING METALS BY ELECTROLYSIS; Hans A. Frasch, Hamilton, Canada. App. filed Sept. 15, 1900. The metals represented in the anode are brought in solution, and by



669,299.—Dynamo-Electric Machine.

electrolyzing this solution there is deposited from it at a given tension of an electrolytic current, certain metals upon the cathode; at the same time the electrolyte is constantly resaturated by passing it repeatedly through anodes of the same composition.

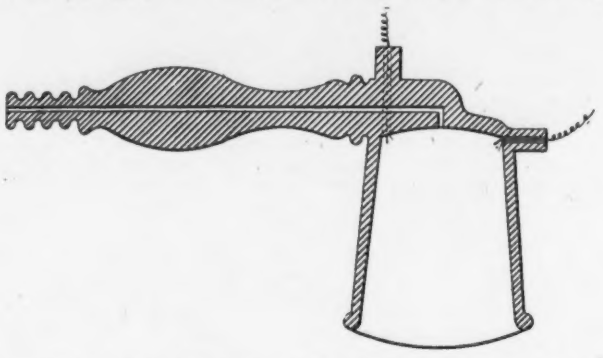
669,459. ELECTRIC RAILWAY; C. E. Fournier, New London, Conn. App. filed June 7, 1900. Details of an overhead trolley switch.

669,471. TELEPHONE KEY; E. E. Yaxley and C. C. Cadden, Chicago, Ill. App. filed Sept. 22, 1899. The key consists of a lever carrying an insulating roller at the end, which may be thrust between the ends of a series of spring contacts to close certain circuits and open others.

669,486. SECONDARY BATTERY; H. C. Porter, Chicago, Ill. App. filed Dec. 27, 1898. A battery plate separator for storage batteries, consisting of a plurality of vertical posts provided with notches, and a plurality of horizontal strips secured in the notches in each of the posts on the opposite sides thereof, said posts and strips being composed of insulating material, and said strips being staggered relatively to each other on opposite sides of the posts.

669,487. BATTERY PLATE OR GRID; H. C. Porter, Chicago, Ill. App. filed Feb. 5, 1900. The grid is made of a series of vertical bars embraced on each side by series of horizontal bars.

11,893. PROCESS OF OPERATING TWO LOCAL PRIMARY BATTERIES, AND REGENERATING ELEMENTS THEREOF; Henry K. Hess, Albert



669,336.—Method of Local Application of Electric Treatment to the Human Body.

J. Shinn and Carl Hering, Philadelphia. Original, No. 649,841, dated May 15, 1900. App. for reissue filed Jan. 24, 1901. (See Current News and Notes.)

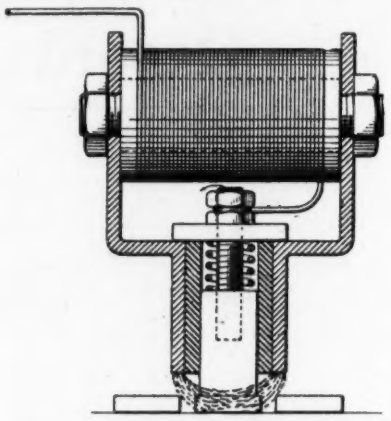
The following patents, issued Feb. 4, Feb. 12 and Feb. 26, were delayed in transmission from the Patent Office:

667,324. SHADE HOLDER FOR ELECTRIC LAMPS; Geo. M. Lane, Newark, N. J. App. filed Sept. 17, 1900. A base plate has offstanding ears, at opposite ends to which are pivoted clamps. Between opposite clamps are springs which force the jaws of the clamps inward to engage positively with the shade or globe, the clamps serving also to prevent lateral displacement of the shade.

667,435. CARTRIDGE FIRED BY ELECTRICITY; Wm. Friese-Greene and Percy Edwin Knell, London, Eng. App. filed Dec. 30, 1899. A charge consists solely of metal wires to be vaporized by the passage through the same of a current of electricity, whereby explosive energy is generated.

667,508. AUTOMATIC SWITCH; Joe D. Edwards, Washington, D. C. App. filed Oct. 30, 1900. A switch-operating device mounted upon the ordinary plow of an electric car, with a lever mechanism for operating the switches. There is a series of pivoted switch points, a trip lever connected therewith and located below the surface of the track, a plow carried by the car, a spring-controlled bar slidably mounted on the car and having a trip thereon for engaging the trip lever, a roller mounted on the plow holder and a cable passing through and attachably connected to the bar.

667,714. AUTOMATIC APPARATUS FOR FEEDING SHEETS OF PAPER TO PRINTING MACHINES; Max Koenig, Guben, Germany. App. filed May 15, 1900. An arrangement for feeding paper which includes an electromagnetic device by means of which the feeding apparatus is kept at a standstill until the sheet that has been pushed forward is removed from the pile by means of the press laying-on arrangement.



669,438.—Magnetic Blow-Out Brush Holder.

668,446. ELECTRIC LIGHT FOR SHOW WINDOWS; Sig Hirsh, New Haven, Conn. App. filed Oct. 10, 1900. Electric light conical reflectors with the lower edges flush with the ceiling of the show window.

668,842. APPARATUS FOR ELECTROLYTICALLY EXTRACTING AND DEPOSING GOLD AND SILVER FROM THEIR ORES; Albion M. Rouse, Denver, Colo. App. filed May 28, 1900. The apparatus consists of the combination of a series of tubs having anodes and cathodes arranged therein, an agitating tube in communication with the tubs at both upper and lower ends, an agitator located in the tube provided with means for elevating the ore pulp therein, and perforated conduits located in the upper ends of the tubs adapted to receive the ore pulp from the tube and discharge it into the tubs.